XDi

4189350066

fleXible Display indicator

XDi-net CANopen® reference manual

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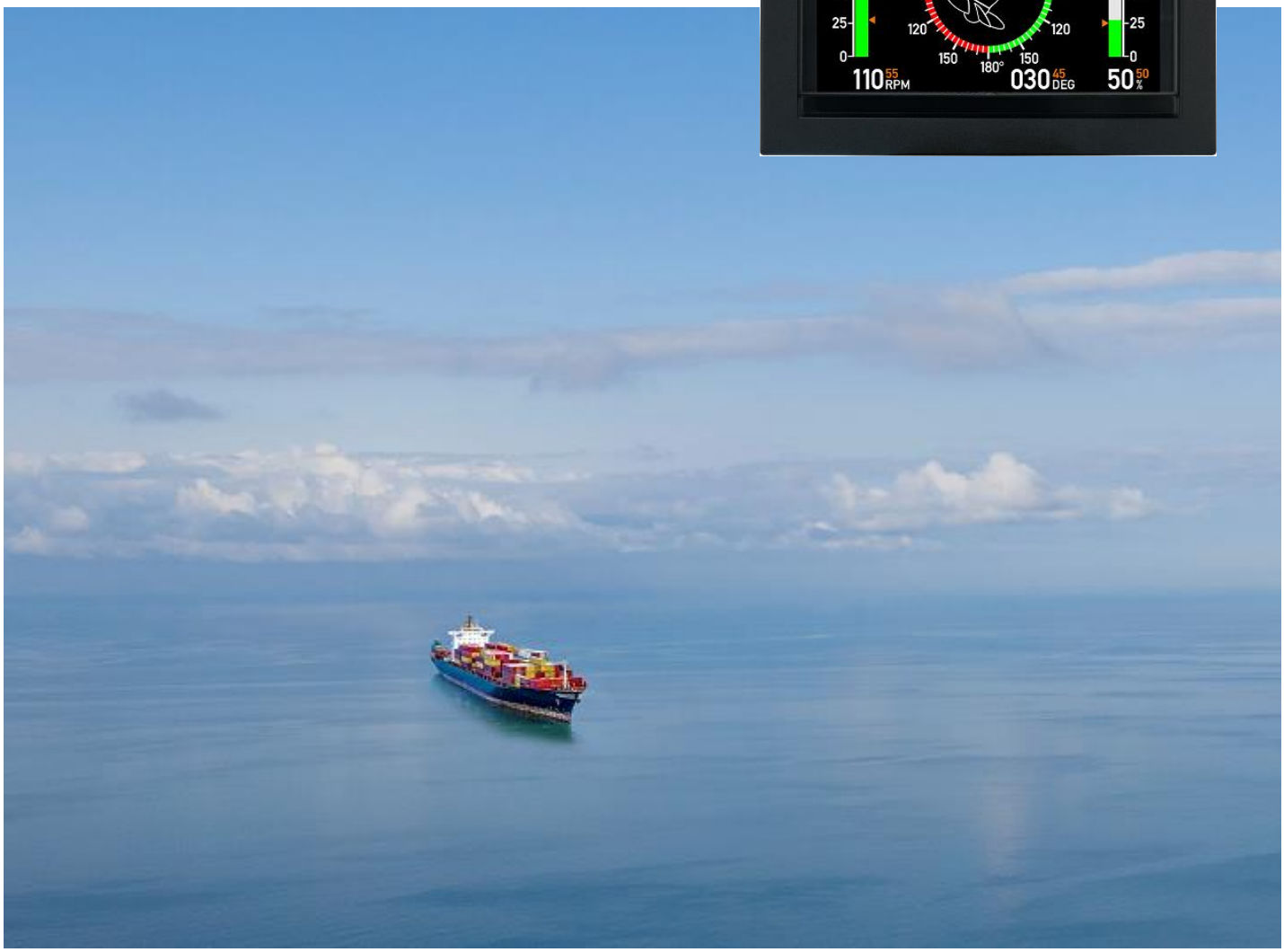


1 Introduction

This document describes the standard CAN bus interface of the XDi product series. The XDi can be pre-configured to act as a normal CANopen device and when the special XDi-net functionalities are activated, easy plug and play data sharing and setup synchronisation are available.

CANopen is a very open and flexible protocol, which usually requires some knowledge and the right configuration tools to configure a system.

To counter this obstacle, the XDi series offers XDi-net, a pre-defined way of using the CANopen protocol and the manufacturer-specific options to create a plug and play system.
The XDi-net is based on CANopen and it is compatible with CANopen devices that use the same physical bus. The XDi-net functionalities make it very easy to install a self-containing CAN bus system without a master and complicated configuration.
The XDi-net includes common rules for interpreting standard CANopen communication, dimmer control in groups and synchronisation of rules and parameters via the CAN bus.
It also makes sharing of analogue, digital, NMEA0183 or dimmer input data easily available from one XDi unit with extension modules to other XDi indicators on the CAN bus, without any complicated setup.

System integrators that use XDi in their system may also benefit substantially by the XDi-net plug and play for easy installation and data sharing.

Please note that when the XDi-net is active, there are a few restrictions that must be followed to secure trouble-free operation; these restrictions are described in detail in this document.
The XDi series of indicators uses the manufacturer-specific part of the CANopen object index table as the backbone, which opens for advanced integration and automated configuration.

The CANopen implementation is based on:

- CiA Draft Standard 301 - Application Layer and Communication Profile - Version 4.02
- CiA Draft Standard Proposal 302 - Framework for CANopen Managers and Programmable CANopen Devices - Version 3.3.0
- CiA Draft Standard Proposal 305 - Layer Setting Services and Protocol - Version 1.1.1
- CiA Draft Standard Proposal 307 - Framework for Maritime Electronics

It is not the purpose of this document to describe all the functionalities of the CANopen communication protocol that is implemented in the XDi and running according to the CANopen standard.

Go to the website **www.can-cia.org** to download a detailed explanation of CANopen.

1.1 EDS file for the XDi CANopen indicator

The XDi concept is very flexible and uses a library structure, in which indicators and setup parameters will be selected during the initial installation, and some default parameters and CAN settings may be changed from the XDi user and installation menus.
However, this flexibility makes it practically impossible to make a usable EDS file that covers all combinations.
The available EDS file is therefore made as a general EDS file, which can be used to read and write the general CAN parameters and to make automated configuration of the XDi.
The library-specific input parameters must be handled manually or in combination with the general XDi EDS file.
The library-specific CAN parameters are found in the XDi library specification document that is made for each DEIF standard or customised library.

The EDS file description is found in

Appendix 8 - EDS file description, and the EDS file can be submitted on request or can be downloaded from http://www.deif.com/software/software-download.

When an EDS file is used in a configuration tool for setting up a CAN system, it will in most cases be necessary to edit the content of the general EDS file to match the used virtual indicator library and the selections made during XDi installation setup. See examples in Appendix 8.

1.2 Use of CAN in XDi indicators

The XDi series is designed for integration in a large variety of systems that utilise the CANopen protocol in many different ways, which this very open standard renders possible.

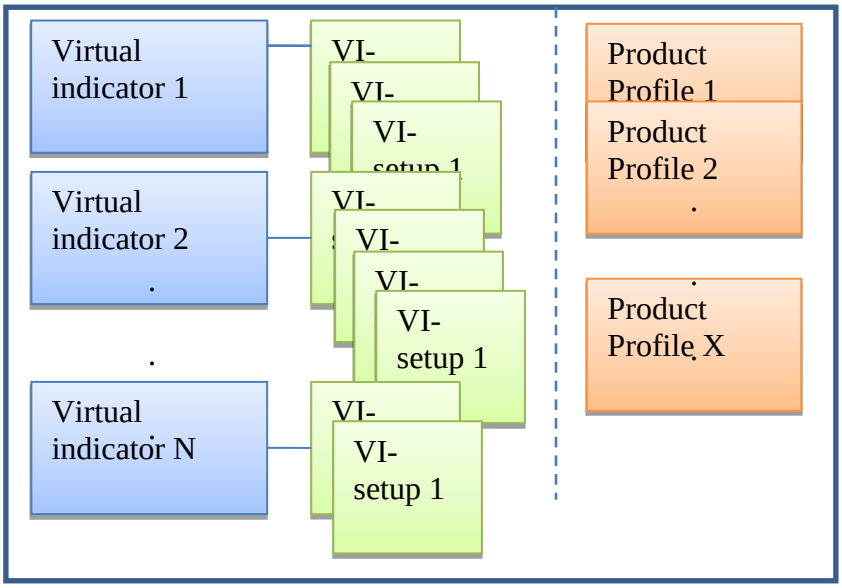
Therefore, the goal has been to make the XDi CAN interface quite flexible and able to adapt to specific customer needs.

The virtual indicator with scale and one or more pointers, bar graphs and digital readouts are defined in the “virtual indicator file” (VI).

Input and configuration parameters for each virtual indicator (VI) are defined in a virtual indicator setup profile (VI setup profile, or short VS). It is possible to specify up to 50 different VI setup profiles for each virtual indicator. This is useful if indicator inputs and default parameters must be set differently in different system configurations in which the indicator is used.

The same applies to product-related parameters, like CAN bus and dimmer group settings; they are stored in a product profile (PP), and they are independent of the virtual indicator that is presented on the XDi display. There may also be up to 50 different product profiles in a library.

XDi must always contain a virtual indicator library to be able to operate.



XDi library structure.

The first time an XDi is started after the installation, a setup wizard will automatically appear and guide you through the selection of:

- Screen rotation
- Node-ID
- Product profile (PP)
- Virtual indicator (VI)
- VI setup profile (VS)
- Finish

In many cases, these six easy steps complete the installation.

Virtual indicators, VI setups and product profiles are all identified by numbers, which makes it possible to make an automated setup via the CAN bus as soon as the Node-ID is assigned.

DEIFs XDi design rules for backward compatibility secures that form, fit and function and the unique PP, VI and VS numbers will not change at a later library update where new indicators and/or profiles are added.

1.3 CAN Node-ID

The CAN Node-ID is the **unique identifier** for a device in the XDi-net system, and it is fixed after installation/commissioning.

The library contains a default Node-ID that will be suggested as the default selection in the start-up wizard.

The Node-ID selection is the first operation that is performed in the start-up wizard.

If heartbeat is active, the XDi will monitor this from all nodes on the CAN bus. If a node ID is already in use by another device, the Node-ID will be greyed out in the wizard menu and cannot be selected.

If for some reason later is another device using the same node ID as an active XDi, then this XDi will show a warning pop-up indicating a Node-ID conflict on the CAN bus.

Recommendation: write the CAN Node-ID on the small white label behind the front frame of the XDi unit.

The XDi unit will not be active on the CAN bus until the Node-ID is selected.

1.3.1 Node-ID shift

In normal CANopen installations, the Node-ID is very important for data routing and system configuration, so you should be very careful when you change the Node-ID in a running installation.

If the XDi-net broadcast protocol is used, the Node-ID is not critical for the normal operation, but if your CAN system uses automated setup via CAN, you should be equally careful when you change the Node-ID.

It is possible to re-open the setup wizard to change the Node-ID. If it is changed because the unit is to be used as a service unit elsewhere in the system, it is recommended to make a master reset instead, this will restore the factory settings of the XDi.

1.3.2 Node-ID shift via CANopen

A CAN controller is able to shift the Node-ID by using the CANopen LLS setup procedure. This is a standard CANopen procedure, but it is described in the example in appendix 9 Glass Bridge - Full CAN setup without using front buttons.

1.4 General CAN bus setup

XDi 96, 144 and 192 all have two independent and galvanically insulated CAN ports.

The general CAN bus setup for both CAN ports is pre-defined in the product profile.

Settings can be changed from the XDi installation menu.

CAN function	XDi-net ON	XDi-net OFF	Note
CAN bus mode:	Single 2 x single Redundant	Single 2 x single Redundant	May even be OFF, if the CAN bus is not used.
Bit rate CAN1 (kbps):	20, 50, 125, 250, (500, 1000)	20, 50, 125, 250, (500, 1000)	
Bit rate CAN2 (kbps):	20, 50, 125, 250, (500, 1000)	20, 50, 125, 250, (500, 1000)	
XDi-net functions:	ON	OFF	XDi-net functions are disabled.
XDi-net variable data on:	CAN1, CAN2, CAN1&2 (not OFF)	OFF Menu greyed out!	Broadcast of XDi data to other XDi units, dimmer values, and variable data from analogue or digital inputs.
Send XDi-net setup synch. data on:	CAN1, CAN2, CAN1&2 (not OFF)	OFF Menu greyed out!	The XDi will not be able to synchronise parameter changes if this function is OFF.
Send CAN heartbeat on:	CAN1, CAN2, CAN1&2 (not OFF)	NO, CAN1, CAN2, CAN1&2	Must be ON when running XDi-net and will be permanently ON if redundant CAN is selected.
Auto start XDi on the CAN bus:	YES	YES/NO	Must be ON when running XDi-net.
Send CAN start command on CAN bus:	NO, CAN1, CAN2, CAN1&2	NO, CAN1, CAN2, CAN1&2	Used to activate a CAN sensor without built-in auto-start
DAM-MPDO to be used:	NONE or RPDO2-4 *)	NONE or RPDO1-4	If MPDO data transfer is used, an RPDO must be selected.

*) The SAM-MPDO used for XDi-net is by default RPDO1 and it is therefore not possible to select RPDO1 for DAM-MPDO communication, if XDi-net is active.
It is possible to have XDi-net moved to RPDO 2, 3 or 4, but it cannot be changed from the XDi menu, it can only be implemented in a customized product profile.

1.4.1 CAN bus modes

Both CANopen and XDi-net can be set up to one of the following bus modes:

Mode #	XDi CAN mode	CAN1	CAN2
1	XDi-net/CANopen – single	Active	OFF
2	XDi-net/CANopen – 2 independent	Active	Active
3	Redundant CAN	Primary active	Secondary active

Mode 1: "Single CAN bus", only CAN1 is active.
Mode 2: for "two independent CAN buses" the settings are normally the same for both buses, but they may be set up differently for bus 1 and bus 2. However, the Node-ID will always be the same on both buses!
Mode 3: redundant CAN bus mode may be used in systems controlled by a CAN master (NMT), it should not be used in systems without a master.

1.4.2 XDi-net dual communication (mode 2)

Service	CAN1	CAN2	Note
PDO	TX/RX A	TX/RX B	
MPDO	TX/RX A	TX/RX B	
XDi-net	TX/RX A	TX/RX B	XDi-net broadcast (SAM-MPDO)
SDO	TX/RX A	TX/RX B	
EMCY	TX/RX A	TX/RX B	
Sync	TX/RX A	TX B	Not used by XDi
Time	TX/RX A	TX B	Not used by XDi
NMT	TX/RX A	TX/RX B	
Error control	TX/RX A	TX/RX B	

A and B indicate whether the same or different services are running on the two channels. A on both = same services (data) running on both buses, A and B = different services (data) on the two busses.

In mode 2 it is possible to run two electrically independent CAN buses as one bus.

Input and setup data on both channels will be handled equally.

If XDi-net is active on one CAN port, then XDi receives only XDi-net data from that CAN port.

If XDi-net is active on both ports, XDi will receive XDi-net data from both CAN ports, if the same data is available on both CAN ports then XDi will use both. If Xdi-net input data for an indicator does not have the exact same value on both CAN busses it may cause fluctuation of data presentation. If it is dimmer input that is different it may cause backlight flickering.

So be careful when transmitting the same XDi-net data ("redundant" data) on both CAN busses, they must be the same.

Data transmission (data sharing) from an XDi with extension module can be setup so that it is shared on: CAN1, CAN 2 or both CAN 1&2 and can also be set OFF. This is normally setup in the relevant setup profile, but can be changed from the XDi menu.

TPDO input data for a virtual indicator can come from one of the two or from both CAN ports – if it is input data for a virtual indicator this is predefined in the VI setup profile and if it is dimmer data it is predefined in the product profile. This can also be changed from the XDi menu.

1.4.3 XDI-net redundant communication (mode 3)

Service	CAN1 Primary (Default)	CAN2 Secondary (Redundant)	Note
PDO	TX/RX A	TX/RX A	
MPDO	TX/RX A	TX/RX A	
XDi-net	TX/RX A	TX/RX A	XDi-net broadcast (SAM-MPDO)
SDO	TX/RX A	TX/RX B	
EMCY	TX/RX A	TX/RX A	
Sync	TX/RX A	TX A	Not used by XDi
Time	TX/RX A	TX A	Not used by XDi
NMT	TX/RX A	TX/RX B	
Error control	TX/RX A	TX/RX B	

A and B indicate whether the same or different services are running on the two channels. A on both = same services (data) running on both buses, A and B = different services (data) on the two buses.

Variable data may be available on both channels.

By default, data is accessed from the primary channel, shift to redundant data on the secondary channel is controlled by the CAN master.

1.5 Supported bit rates on CAN

XDi supports: 20 kbit/s, 50 kbit/s, 125 kbit/s (default), 250 kbit/s, 500 kbit/s, 800 kbit/s and 1 Mbit/s.

20 kbit/s and 50 kbit/s are for long distance data transfer.

Bit rate definition:

Index CiA e305 p. 10.	Bit rate	CiA 301 Max. CAN cable length	Max. recommended total CAN cable length*)	Max. drop cable length **)	Accumu-lated max. drop cable length	Note
0x00	1000 kbit/s	25 m	18 m	0.5 m	4 m	Not recommended
0x01	800 kbit/s	50 m	36 m	1 m	7 m	Not recommended
0x02	500 kbit/s	100 m	70 m	3 m	16 m	Good network layout
0x03	250 kbit/s	250 m	150 m	6 m	30 m	
0x04	125 kbit/s	500 m	300 m	10 m	60 m	Default
0x05	Reserved	-	-	-	-	
0x06	50 kbit/s	1000 m	500 m	15 m	100 m	
0x07	20 kbit/s	2500 m	1000 m	20 m	250 m	
0x08	10 kbit/s	-	-	-	-	Not supported by XDi
0x09	Automatic bit rate detection	-	-	-		Not supported by XDi

*) The recommended cable length allows for the use of connections without perfect impedance match and the use of some drop cables.
**) The number of drop cables should be limited to a minimum, since it affects the network performance. Remember to include the length of any drop cable into the calculation of the total cable length.

1.5.1 Change of bit rate via CANopen

Change of bit rate via CAN may be performed by using the LLS protocol and should be a bus wide command (note that not all devices on the bus may support LLS).

NOTE: XDi products are not able to send a broadcast command to change the bit rate of all XDi devices on the CAN bus (NMT function).

1.6 CAN protocols available in XDi

The CAN protocol is defined by the parameter settings in the product profile.

- XDi-net if set to ON
- Pure CANopen if XDi-net is turned OFF

As a general rule, the CAN mode must be the same for all XDi devices in the CAN network.

1.6.1 CANopen mode

When the XDi-net is disabled, the XDi will operate in standard CANopen mode and act as a slave device. It will normally be set up to act as a self-starting device, receiving CANopen data from a CANopen source without need for a CAN master (NMT) in the system. The self-starting function can be turned OFF from the XDi menu or it can be default turned OFF in a customized product profile.

1.6.2 XDi-net mode

The XDi-net is built on top of CANopen to make it plug and play and still compatible with CANopen.
A few restrictions must be taken into consideration for systems, in which XDi-net products are mixed with other standard CANopen products.
In full XDi-net mode, the following XDi-net functions are available:

- Synchronisation of other XDi units after acknowledgement of changes like: zero set, max./min. adjustments and other

parameter changes related to variable CAN input data.

- Manual adjustment of CAN data conversion, routing and synchronisation with other XDi-net units using the same CAN data source (RPDO or TPDO).
- Distribution of data from extension modules on CAN using XDi-net data broadcast (MPDO-bc)
- Distribution of dimmer settings and colour shift commands using XDi-net broadcast.

The XDi-net main functions may partly be selected for one or for both CAN ports:
XDi-net variable data: use XDi-net for variable data sharing, transmit or receive.
Send XDi-net setup synch. data: use XDi-net for synchronisation of changes.

1.6.3 XDI-net restrictions on CANopen

When the XDi-net is activated in the product profile or via the XDi installation menu, there are some important restrictions to be taken into consideration.

1.6.4 Reserved CAN PDOs – COB-IDs

XDi-net setup synch. data

If setup synchronisation via the XDi-net is activated, then Node-ID 127 and related RPDOs and TPDOs are restricted for XDi-net use only.

The restricted COB-IDs are:

TPDO 1-4: COB-ID: 0x1FF, 0x2FF, 0x3FF, 0x4FF

RPDO 1-4: COB-ID: 0x27F, 0x37F, 0x47F, 0x57F

All synch. data is by default sent using COB-ID: 0x27F (RPDO1/Node-ID 127) from any XDi on the network.
XDi units are only listening for synchronisation data in this COB-ID.

XDi-net variable data

If this function is activated, then RPDO1 for all nodes is reserved for XDi-net data distribution and it cannot be used for any other types of communication.
All COB-IDs in the range 0x200 to 27E are restricted for this use only.

1.7 Restricted Node-ID - service unit

CAN Node-ID 127 is reserved as the parking address for a non-configured XDi (for example service unit). The related PDOs (COB-ID: 0x1FF, 0x27F, 0x2FF, 0x37F, 0x3FF, 0x47F, 0x4FF, 0x57F) are reserved for special XDi-net communication.

Master reset of an XDi unit to “service unit mode” will park it on Node-ID 127, ready for setup either manually or via CAN.

Node-ID 127 must not be selected as a normal node if XDi-net is active!

Node-ID 127 must not be used as a normal CAN Node-ID for any CANopen device in a network using XDi-net functionality!

While an XDi-net device has this “service Node-ID”, it will not send out data (PDOs or MPDOs), but it will send out heartbeat to indicate its existence, and it can be approached using SDOs, and the Node-ID can be shifted using LLS.

1.7.1 XDi-net conflicts

If other CANopen devices in a CAN system require access to RPDO1 for non-XDi-net use or if Node-ID 127 is required for other use, then the XDi-net must be partly or entirely turned off.

1.8 Self-starting device

Self-start is the ability to switch to operational mode without a command from a master.
This function is set up in the product profile and may also be changed to ON/OFF from the installation menu.
An XDi unit that boots up in setup mode (setup wizard is presented on the display) will “self-start” as soon as the Node-ID number is selected and acknowledged with the OK softkey.
An XDi unit in an operating system (already set up) will self-start after 1000 mS (default), but it may be set up differently via CANopen.
In XDi-net mode, the self-starting function is always ON and cannot be set to OFF.

1.9 Automatic start command

When active, the XDi will automatically send out the NMT start command after boot-up (COB-ID=0x000). This command will start other manufacturers’ CANopen sensors that are not self-starting. This function may be handy when a sensor is used as data source in an XDi-network.
By default, the function is OFF.

NOTE: Sensors not starting automatically must boot up faster than XDi to make sure they are by the XDi start command that is only sent once.

1.10 Heartbeat

Heartbeat is always active in XDi-net mode. The heartbeat will start as soon as the Node-ID is selected and acknowledged (the unit is active and in operational mode).
The heartbeat is used to identify active nodes on the network during commissioning. CAN Node-IDs in use are greyed out in the XDi Node select menu (startup wizard) and cannot be selected as Node-ID for another XDi unit.
The HB-producer time is default 500 ms. (XDi transmits HB approximately every 500 ms)
Default HB-consumer time is set to 1500 ms (or 3x the HB-producer time).

1.10.1 In CANopen mode

The heartbeat is default set to either ON or OFF in customized product profiles, this may be changed from the XDi installation menu.
If redundant CAN mode is selected, the heartbeat producer is default ON and set to 500 ms, and the HB-consumer is ON and set to 1500 ms (3x the producer).

2 CAN data source for a virtual indicator

2.1 Object index for variable data

All normal data types used in marine bridge applications have pre-defined locations in the manufacturer-specific section of the object index table.

Common for all types of pointers, bar graphs or digital readouts that are used in a virtual indicator, is that input data is picked from the pre-defined location in the object index table from 0x3000 to 0x3FFF.

XDi index	Max. # objects Instance	Object types	Note
0x3000 – 0x3FFF	4096	Variable XDi input/output data	
0x3000-0x31FF	512	Propulsion	
0x3000-0x300F	16	Azimuth & Rudder	"-" = bow turns to port
0x3010-0x301F	16	Rudder%	"-" = bow turns to port
0x3020-0x302F	16	Pitch angle	"-" = astern or portside
0x3030-0x303F	16	Pitch%	"-" = astern or portside
0x3040-0x307F	64	Reserved	
0x3080-0x308F	16	Propeller RPM	"-" = astern or portside
0x3090-0x309F	16	Propeller RPM%	"-" = astern or portside
0x30A0-0x30AF	16	Propeller THRUST%	"-" = astern or portside
0x30B0-0x30BF	16	Propeller POWER%	"-" = astern or portside
0x30C0-0x30CF	16	Propeller LOAD %	
0x30D0-0x31FF		Reserved	
0x3200-0x33FF	512	Engine data	
.....			

First part of the variable data index table. See **Appendix 3** for the full table.

The object index table has space for several instances of the same data type. For example, data type "Propeller RPM" is located in object index 0x3080 to 0x308F, where 0x3080 contains the data type header, and the first instance of "Propeller RPM" is located in object index 0x3081 with sub-indexes, "Propeller instance 2" in 0x3082 and so on.

Pre-defined data types are scaled to an absolute data value (or defined % value) with a fixed pre-defined resolution, for example RPM with resolution 0.1 means that the data value 2000 is equal to 200.0 RPM.

Scaling of all data types to an absolute value makes it possible to present the data value directly in a digital readout.

2.1.1 Variable data format in object index

All the pre-defined data types are scaled to an absolute data value (or defined % value) with a fixed resolution, for example propeller RPM is defined with resolution 0.1, this means that if the absolute data value is 2000, it is equal to 200.0 RPM.

Scaling of all data types to an absolute (or %) value makes it possible to present the data value directly in a digital readout.

All standard variable data values are defined as signed 16 bit (I16), but there may be future data types using unsigned 16 bit or other formats.

This is defined in the object index table.

LSB MSB

‘	Byte 5 (Data MSB)	Byte 6	Byte 7
DATA	DATA	Reserved (don’t care)	

Example: Signed 16 bit value 0xFE16 (Decimal = -490) is presented in byte 4 to 7 as: 0x16, 0xFE, 0x00, 0x00

The actual data value of a data type is located in sub-index 0x02 and the related fixed resolution value can be read from sub-index 0x03.

Commanded data or set-point data is located in sub-index 0x07 and the fixed resolution value can be read from sub-index 0x08.

Resolution value (R) is defined as: (actual value) x 10^R.

Example: actual data 23456 with resolution -1 is equal to 2345.6 and with resolution -2 it is 234.56

2.1.2 Indication of invalid variable data

Some values in the 16 bit variable data field are reserved for error indication:

- Max. positive value: (for example I16: 0x7FFF) = Data not valid or out of range (sign cannot be determined).
- Max. positive value minus 1: (for example I16: 0x7FFE) = Totally out of range positive.
- Max. negative value plus 1: (for example I16: 0x8000) = Totally out of range negative.

This is used for example when an analogue input voltage is out of range.

2.1.3 Data lost - variable data timeout

Variable data is supposed to be updated regularly; if data is not updated after the defined timeout period, (default 3000 ms), “Data lost” will be indicated in a pop-up on the display (If this function is active) and the affected pointer and/or digital readout will start to flash.

The last valid data value is still stored in the index/sub-index and will be presented on the indicator, but flashing.

It is possible in the design process of a virtual indicator or via CAN SDO, to disable the data lost timeout. (Disabling via CAN requires special knowledge – contact DEIF).

2.1.4 Variable data type “Flag”

In object index directory 0x3xxx-3FFF some “Data flags” are defined. They are broadcast using the number of data bytes needed to transfer the content of the actual flag index (1 to 4 byte).

The pre-defined index table of variable data makes it possible to easily broadcast data by using the XDi-net protocol (SAM-MPDO), or to send data directly to an indicator via this index, using DAM-MPDO (or SDO) as described in the next section.

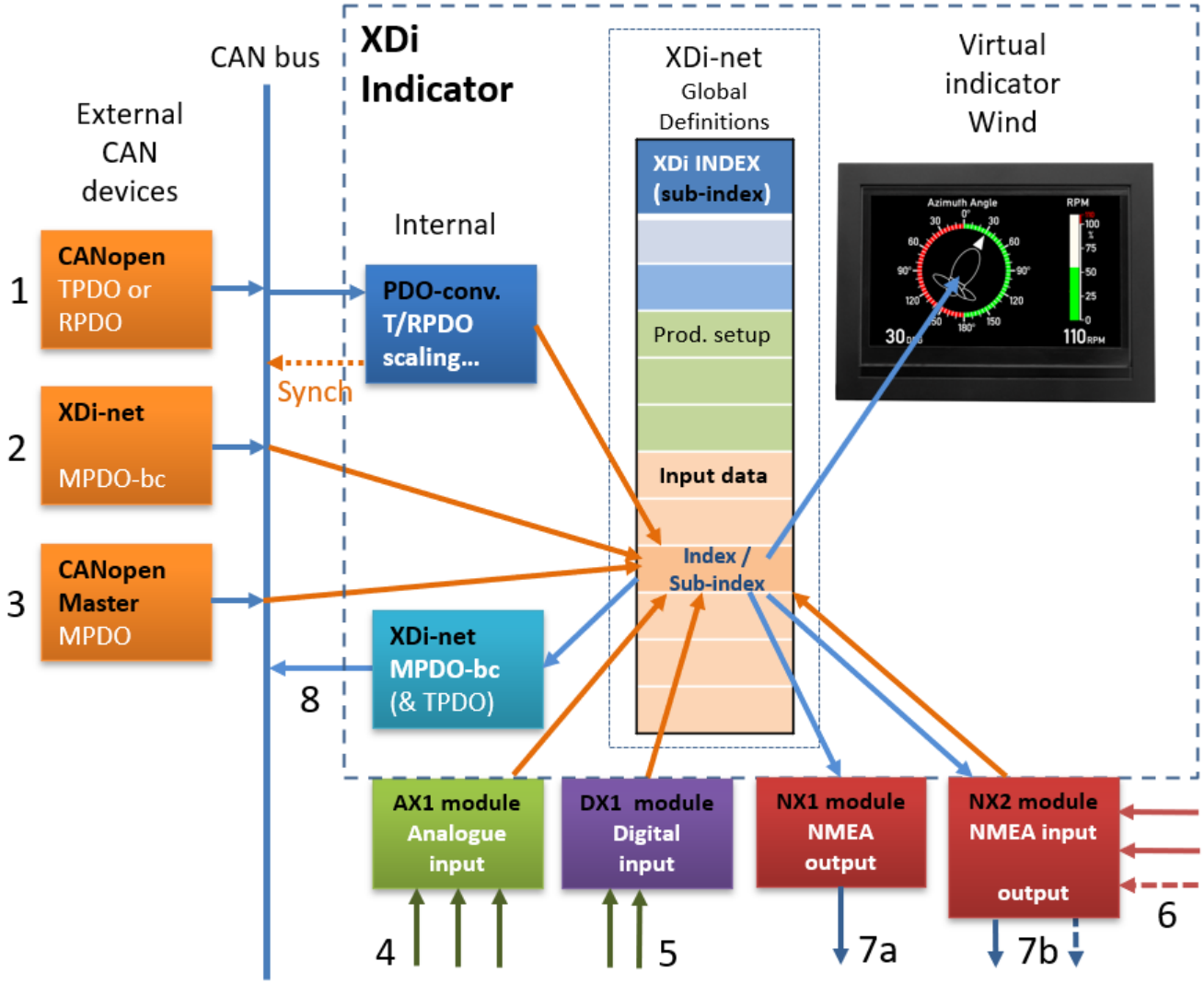
The object index and sub-index for each data type used by a virtual indicator, the resolution and other relevant information can be found in the relevant XDi library specification document (DEIF standard library or customer library), where indicator input is defined in the VI setup profile (VS).

NOTE: In some applications, there may be a need for DAM-MPDO transmission of relative data (for example 16 bit integer) directly into the object index table as input to a kind of universal indicator. This is not the recommended way of using the XDi, but – with some care – it is possible. Space is reserved in the object index table for this type of universal data, but it is not very easy to use. Contact DEIF if you have the need for this in your system applications, and we will do our best to guide you so you obtain the best solution.

How to get data into the object index table

The variable input data settings for an XDi is defined as one of the following:

- In the VI setup profile (VS profile), if it is variable input data for a virtual indicator
- In the product profile, if it is dimmer input data



The indicator pointers and digital readouts, in a virtual indicator, will receive its data from a predefined location in the XDi object index table.

In the above example it is the Azimuth indicator that is showing Azi-angle instance 1 located in index 0x3001, Sub-index 0x02.

There are six main ways of getting variable data into the object index table:

- TPDO or RPDO transfer
- XDi-net data transfer (MPDO-bc, that is a broadcast using SAM-MPDO).
- DAM-MPDO transfer directly addressed to the XDi units with a given Node-ID
- Input signal from an analogue extension module (AX1)
- Input signal from a digital I/O extension module (DX1)
- NMEA input data from a NMEA I/O extension module (NX2)

It is also possible to use SDO (Service Data Object) transfer to enter input data, but it is **not** recommended for variable data. (It is, however, very useful for changing setup parameters.)

IMPORTANT: Independently of the data transfer method used, it is important that there is **only one** source for each data type and instance. If there are multiple sources providing the same data input to a virtual indicator on the XDi, it will generate a jumping or faulty indication.

2.2 XDi-net data transfer

To make data transfer easy and independent of Node-ID and other complicated configurations, XDi-net data is distributed using data broadcast.

In XDi-net, PPDO1 is configured as a SAM-MPDO (Source Address Mode Multiplexed PDO).

Data is broadcast as an absolute (scaled) value from the data source, identified by its Node-ID and the data value is written directly into the pre-defined location for this data type/instance within the object index table (object index/sub-index) of the receiving XDi device.

This SAM-MPDO broadcast is called the XDi-net Multiplexed PDO broadcast (MPDO-bc).

When the data source for a virtual indicator is set up to be XDi-net, no further setup is needed; the indicator will simply receive the broadcast data directly. It does not need to know any COB-ID, source Node-ID or anything else, just plug and play.

2.3 Data distribution using DAM-MPDO

In CANopen process, data may also be distributed using a "Destination Address Mode Multiplexed Process Data Object" (DAM-MPDO). DAM-MPDO data is addressed and sent from a CAN master or controller to each XDi individually. Like in XDi-net, data is routed directly into the defined object index/ sub-index. One of the RPDOs (2, 3 or 4) must be assigned as a DAM-MPDO channel, the default selection is made in the product profile and may be changed via the installation menu. DAM-PDO takes up more bandwidth in systems where many XDi indicators are presenting the same data, because data is sent to one indicator at a time.
NOTE: the XDi requires variable data to be updated regularly, at least every 3 seconds (default).

IMPORTANT: If XDi-net is active, restrictions apply to any other use of RPDO1 - see the section "XDi-net restrictions on CANopen".

When a data source is set up for XDi-net, it will receive either an XDi-net data broadcast or a DAM-MPDO data transfer. However, if XDi-net variable data is disabled in the product profile or via menu, then source data is limited to the DAM-MPDO transfer.

In DAM-MPDO mode, the input source for an indicator (or a dimmer group) is set up as XDi-net input.

2.4 TPDO or RPDO as data carrier

Transmit Process Data Object (TPDO) is very often used to transmit data from a CANopen-based sensor like a rudder angle transmitter (encoder). A TPDO contains a maximum of eight data bytes.

The XDi supports the retraction of several mapped data types from the same TPDO.

It can for example be when: Pitch angle, %Pitch, RPM and %RPM are mapped into the same TPDO using two bytes each.

Receive Process Data Object (RPDO) is quite similar to TPDOs, and XDi is able to use either type as input.

2.4.1 PDO converter

The XDi software contains a number of "PDO converters" that are able to convert and route either a TPDO or an RPDO into the object index table. PDO converter setup parameters for variable input data are defined in the VI setup profile (VS), and dimmer input data is defined in the product profile (PP).

A PDO converter receives the incoming data package contained in the defined TPDO (or RPDO), converts data using the default scaling rules from the setup profile and sends it as an absolute scaled data value to the defined object index location.

The PDO converter may also be configured to pick one of several data packages out of a mapped PDO.

The PDO converters are a very powerful tools, but it is a good idea to make a data structure before you start making a customised CAN solution using TPDO or RPDO broadcast.

The XDi is also able to transmit data from the object index table carried in a TPDO. Either as single data type sent separately in a TPDO, or several data types can be mapped in one TPDO. Please note that data in the object index table is absolute values, with a defined resolution and data unit and cannot be re-scaled before transmission.

2.4.2 TPDO and RPDO used for data broadcast

The fact that the PDO converter in the XDi is able to receive and translate any of the TPDOs or RPDOs defined in CANopen makes it possible to use TPDOs and RPDOs for data broadcast.

For each data type in use, you must assign either a unique RPDO or TPDO (TPDO1 if XL sCAN is also to be able to read it).

Alternatively, define a unique mapping location for all used data types inside a TPDO or RPDO.

Then an XDi unit on the CAN bus can be pre-configured to listen for precisely that TPDO or RPDO and data mapping locations that contains the source data to be use.

This will work as a data broadcast in line with the XDi-net, but it requires some work to define the structure of all TPDOs and/or RPDOs.

Example A:

The DEIF RTC 300 azimuth/rudder transmitter (encoder) is assigned Node-ID 1 and transmits the measured azimuth propeller angle as a signed 16 bit integer (I16) located in byte 0 and 1 of TPDO1 – that is COB-ID 0x181.

The XDi is set up to present azimuth virtual indicator 2 (VI002) designed for forward bridge and using VI setup 1 (VS01).

In VS01, an azimuth PDO converter is assigned to receive and convert the azimuth angle data to the indicator. In this example, the RTC is set at 180 deg. and transmits value 0x7FFF, it is converted to an absolute angle value of 1800 (resolution 0.1) and stored in object index 0x3001-02. The virtual indicator azimuth disk pointer picks the absolute angle value (1800) from this index, presents it on the azimuth scale and, in addition, presents it in a digital readout as 180 deg.

There are three other similar XDi units in the CAN network, one on each bridge wing.

The ones on the wings must use the same indicator as above, VI002, and also the same VI setup, VS01.

They will all receive the relative azimuth angle value directly from the RTC transmitter.

Alignment of TPDO data

The data received in a TPDO (or RPDO) is available for all XDi units on the same CAN network, so normally data is not retransmitted using XDi-net broadcast. Instead, any manual change of the PDO conversion parameters made via the XDi menu may be automatically synchronised with other XDi units on the CAN bus using the same TPDO, just select Yes to “Synchronise parameter change on network” in the popup window when you leave the installation adjust menu.

Example B:

If a DEIF RTC 300 angle transmitter is not aligned correctly and has a zero offset, then this can be corrected via the XDi installation menu in one of the XDi units using this angle.

When the adjustment is finished and you leave the menu, select “YES” in the menu window to synchronise. Then the corrections are automatically sent via XDi-net to all other XDi units presenting this azimuth angle.

Integration with XL sCAN

In systems where a combination of XDi and XL units (sCAN) is used, it can be beneficial to use the XDi as a data converter and router to supply calibrated and adjusted data to the XL indicators in the system.

IMPORTANT: Traditional XL indicators with sCAN interface do not support data mapping in a TPDO, data must be located in byte 0 and 1. Also note that sCAN only supports TPDO1.

XL sCAN does not support TPDO adjustment synchronisation sent from an XDi. See alternative solution in example C below.

Example C:

The DEIF RTC 600 azimuth/rudder transmitter is used in a combined XDi and XL system. The XDi (Node-ID=17 (0x11)) is receiving relative angle data from the RTC (I16) located in COB-ID 0x181. The TPDO converter in the XDi translates the incoming angle to +/-500 (= +/-50.0 deg.). The VS profile for this indicator also contains a TPDO output, that transmits this angle on CAN using COB-ID 0x191 (0x180+0x11) and located in byte 0 and 1.

Now all the XL sCAN rudder indicators in the network can receive data from XDi.

The XL indicator must be ordered with source ID = 17 (sID = 17 [0x11]), and the ordered CAN input scaling must be “Absolute” and with 50.0 deg. PS = -500; 0 deg. = 000; and 50.0 deg. SB = +500.

After installation of the RTC on the rudder, alignment and calibration can be made directly in the XDi menu, and the angle value transmitted from this XDi will be aligned and calibrated correctly, for the XL indicators to use.

No further calibration should be necessary.

2.5 Extension module data sharing

Analogue or digital input signals from an AX1 or DX1 extension module are converted to absolute data values and/or % values and subsequently stored in the object index table, dependent on data type and instance. The conversion parameters are pre-configured in the VI setup profile for the selected virtual indicator.

2.5.1 Output - XDi-net data broadcast

The converted analogue or digital data can be shared on CAN as an XDi-net broadcast; this is quite easy to use and always available in a VI setup profile that supports analogue or digital signals.

The data that is sent out is the absolute (or %) data value from the object index table. All standard data is sent as a signed 16-bit value.

An XDi with AX1 module snapped on acts as an analogue to CAN converter, and with a DX1 snapped on, the XDi acts as a digital to CAN converter (for example RPM from inductive pickup to CAN converter).

Data will be available for all other XDi units on the CAN bus that are set up to use XDi-net data.

2.5.2 Output - TPDO/RPDO

Alternatively, or in addition, the converted analogue and/or digital data may be sent in a TPDO or RPDO, however, this requires that support for T/RPDO output is pre-configured in the VI setup profile (VS).

The data that is sent out is the absolute (or %) data value from the object index table. All standard data is sent as a signed 16-bit value.

Up to four data types (2 bytes each) may be mapped into the same TPDO or RPDO, for example as input for other CAN devices on the bus.

This must also be pre-configured in the VI setup profile.

NOTE: Unmapped transmission of TPDO1s is the method to use when XL sCAN indicators are integrated into the XDi system.

2.6 Overview of CAN data sources

The following CAN input types can be used to source data into the object index table:

Data carrier	Absolute data value *)	Relative data value **)	CAN PDO converter used		Data can be manually adjusted ***)	Note
			Routed	Con-verter		
XDi-net MPDO-bc	☑	Not recom-mended	—	—	—	Data is absolute values and is routed directly to the multiplexer object index.
DAM-MPDO	☑	Not recom-mended	—	—	—	Data is absolute values and is routed directly to the multiplexer object index.
TPDO/ RPDO	☑	—	☑	—	—	Data is absolute values. The PDO converter is set up to route data to a defined object index. (No conversion).
TPDO/ RPDO	—	☑	—	☑	☑	Data is a relative value. The PDO converter is set up to convert to an absolute value and route it to a defined object index. It can even be setup to deliver both actual and % data from the same TPDO or RPDO.

*) Absolute data means that the value represents the data directly and it must be scaled correct according to the data definition for the selected index/sub-index.
**) Relative data will be scaled and off-set adjusted before it is stored in the object index/sub-index as an absolute value.
***) TPDO/RPDO data received via a PDO-converter can be manually adjusted from the XDi menu, and if you accept synchronisation when you leave the “Adjust” menu, the adjustments will be sent out to all other XDi units on the bus using the data value in this TPDO.

3 Distribution of XDi data

3.1 Data distribution using XDi-net broadcast

In XDi-net, data distribution between XDi units is broadcast from one source to all XDi nodes on the CAN bus that have the need for the broadcast data type and instance.
The easy XDi-net plug and play is not only a protocol to use between XDi units, it can also be used in customer systems where PLCs or CAN controllers can use the XDi-net protocol to broadcast data to XDi indicators and avoid complicated setup.

3.1.1 Transmitting XDi-net data

A unit transmitting XDi-net data must use RPDO1: COB-ID 0x200+Node-ID (its own RPDO1) to transmit XDi-net data, and the source address in the SAM-MPDO must be the unit's own Node-ID.
When "XDi-net variable data on:" in the product profile is set to have one or both CAN ports ON, then data is sent in COB-ID 0x200+Node-ID (range 0x200 to 0x27E).

3.1.2 Receiving XDi-net data

When one or both CAN channels are selected for "XDi-net variable data on:" in the product profile, the XDi unit will listen for XDi-net data on the specified CAN port(s).

When an XDi unit receives a SAM-RPD in any COB-ID from 0x200 to 0x27E, it will check that the source address is equal to the expected Node-ID, to which this COB-ID is reserved.

For example, if the received RPDO1 has COB-ID: 0x260, the source Node-ID (address) in the MPDO must be 0x60; if not, the received SAM-PDO is ignored as "non XDi-net" compatible data.

If data is received in RPDO1 for the special reserved service Node-ID 127with COB-ID: 0x27F, then the source address will be the transmitting unit's own Node-ID, and therefore it is not checked.

NOTE: Such data may also be variable data from a very old XDi-net device that only transmits data in COB-ID: 0x27F; however, this should not be used for variable data broadcast since it may cause collisions if more than one node is sending periodic data. For occasional system calibration or synchronisation data, this is not a problem.

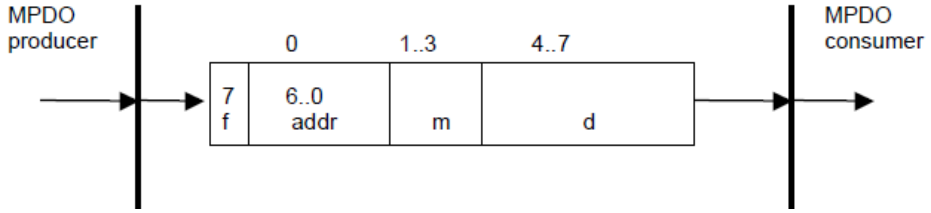
3.2 Customer system's use of XDi-net broadcast

When SAM-MPDO broadcast (XDi-net) using 0x200 to 27E is used to broadcast variable data, it is very important that the data format and object index addressing is correct.

The object index and sub-index used for each data type, including its resolution, will be available in the XDi library specification document. (This may be either the standard DEIF library specification or customer library specification).

3.2.1 CAN frame format for XDi-net broadcast

The XDi-net broadcast protocol uses RPDO1 operated in SAM-MPDO mode. The COB-ID is 0x200+Node-ID.
(One source to multiple receivers).



BYTE 0:

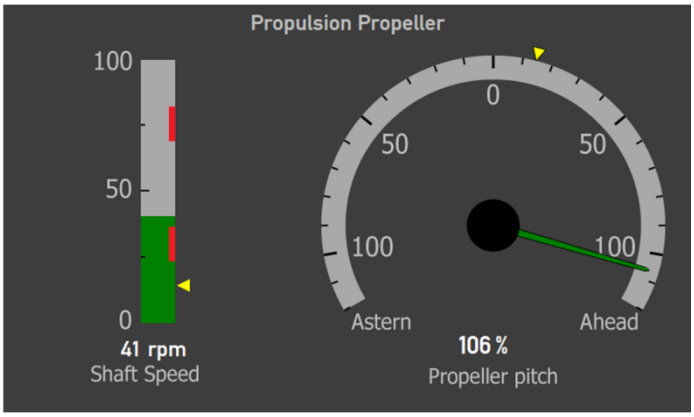
Bit 7:	f = 0	The mode is SAM-MPDO
Bits 0 to 6:	0x01 – 0x7F	Source address is the Node-ID of the unit transmitting data

BYTES 1-3:
Field **m** is the multiplexer, where bytes 1 and 2 contain the object index number and byte 3 contains the sub-index number.

BYTES 4-7:
Data "d" contains the data value of the defined index/sub-index. If the index data is less than 32 bits, the range from MSB and up to 32 bit must be filled with 0s.
(Data in an MPDO cannot be mapped).

3.3 Example 1: transmitting propeller RPM using XDi-net

The virtual indicator below uses VI setup 1 (VS01), where the input source for the RPM bar graph and digital readout is defined as XDi-net broadcast of propeller RPM instance 1.
This data type is located in object instance 0x3080+instance, in this case 0x3801, and the actual RPM data value is stored in sub-index 0x02 with a resolution of 0.1. (The resolution is fixed for each data type, it can be read from sub-index 0x03, in this case the value is -1 since resolution (R) is defined as x10R).
In normal operation, the XDi will listen for all RPDO1s that contain the propeller RPM instance 1 index.



In this example, the XDi receives data from a PLC with Node-ID 5 (0x05) using XDi-net broadcast (SAM-MPDO):

- The PLC sends RPM value 41.0 RPM to the indicator as a 16 bit signed value of 410 (0x019A) because the defined RPM resolution is 0.1 RPM.
- COB-ID for RPDO1, Node-ID 5 is 0x200-0x05=0x205

Transmit data type Propeller RPM								
COB-ID 0x200+Node-ID	Byte 0 Address	Byte Index X_{LSB}	Byte 2 Index X_{MSB}	Byte 3 Sub-index	Byte 4 Value X_{LSB}	Byte 5 Value X_{MSB}	Byte 6 Don't care	Byte 7 Don't care
0x205	05	0x81	0x30	0x02	0x9A	0x01	0x00	0x00

The XDi will present the value 41.0 RPM on the bar graph and present RPM with 1 RPM resolution in the digital readout.

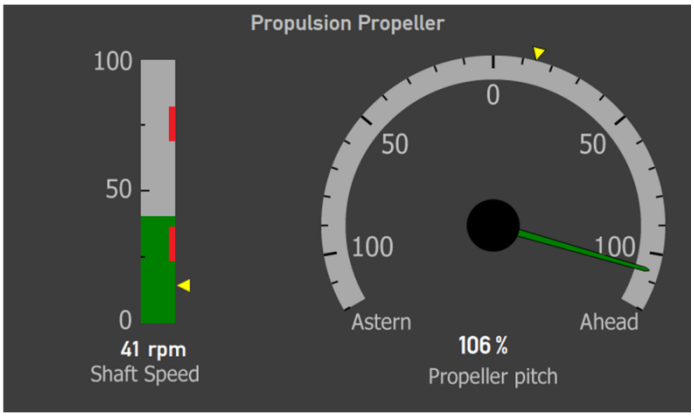
3.4 Example 2: writing to a critical band using XDi-net protocol

All standard variable data types in the XDi object index table have four sets of critical band data, this parameter may, as in this example, be used to mark restricted RPM sectors on an RPM scale where it is not preferable to run the engine, in this example shown as a red section inside the RPM bar graph.

(See the picture below).

Critical band can be designed into bar graphs and round indicators used in a virtual indicator, they can also be used to change pointer colour or bar graph colour. However, in order for it to work, the virtual indicator must be designed to support the desired critical band indication function.

This example describes the use of XDi-net to make a global red sector setup.



Example of two pairs of critical bands used on bar graph

3.4.1 Object index addresses of critical bands

In this example, the virtual indicator is designed with support for two critical bands, indicated as red sectors on the RPM bar graph.
The data type RPM instance 1 is always located in index 0x3081.
Critical band 1: 0x3081 at sub-index 0x0A (critical band 1 high) and 0x0B (critical band 1 low).
Critical band 2: 0x3081 at sub-index 0x10 (critical band 1 high) and 0x11 (critical band 2 low).
(**NOTE:** up to four critical bands may be defined for an indicator).

3.4.2 Setup/activation of critical bands

The default parameter value of the critical band is 0x7FFF . When the index holds this value, the critical band is not activated. When an absolute value is written to one of the indexes, the critical band will be shown on the graph.
If both values high and low for a band hold the same value, then the band will be invisible.
Scaling of the critical band value is the same as the scaling used for absolute data.

Example: writing to critical band
From the CAN controller with Node-ID=0x01, the following must be set up:
When a critical band from 25 to 40 is desired, it is possible to use either critical band 1 or critical band 2. Here the critical band 1 is chosen, and the additional critical band is then placed from 50 to 70. (RPM data resolution is default = 0.1, so critical band data to send is 250 (0x00FA), 400(0x0190) , 500 (0x01F4) and 700(0x02BC).
The XDi-net commands used to place the two bands are shown in the tables below.
Set the value for critical band 1 low at 25.0 RPM (0x00FA) in sub-index 0x3081-11:

Critical band 1 low								
COB-ID 0x200+Node-ID	Byte 0 Addr.	Byte 1 Index X_{LSB}	Byte 2 Index X_{MSB}	Byte 3 Sub-index	Byte 4 Value X_{LSB}	Byte 5 Value X_{MSB}	Byte 6 Don't care	Byte 7 Don't care
0x201	0x01	0x81	0x30	0x11	0xFA	0x00	0xFF	0xFF

Set the value for critical band 1 high at 40.0 RPM (0x0190) in sub-index 0x3081-10:

Critical band 1 high								
COB-ID 0x200+Node-ID	Byte 0 Addr.	Byte 1 Index X_{LSB}	Byte 2 Index X_{MSB}	Byte 3 Sub-index	Byte 4 Value X_{LSB}	Byte 5 Value X_{MSB}	Byte 6 Don't care	Byte 7 Don't care
0x201	0x01	0x81	0x30	0x10	0x90	0x01	0xFF	0xFF

Set the value for critical band 2 low at 500 RPM (0x01F4) in sub-index 0x3081-19:

Critical band 2 low								
COB-ID 0x200+Node-ID	Byte 0 Addr.	Byte 1 Index X_{LSB}	Byte 2 Index X_{MSB}	Byte 3 Sub-index	Byte 4 Value X_{LSB}	Byte 5 Value X_{MSB}	Byte 6 Don't care	Byte 7 Don't care
0x201	0x01	0x81	0x30	0x19	0xF4	0x01	0xFF	0xFF

Set the value for critical band 2 high at 700 RPM (0x02BC) in sub-index 0x3081-18:

Critical band 2 high								
COB-ID 0x200+Node-ID	Byte 0 Addr.	Byte 1 Index X_{LSB}	Byte 2 Index X_{MSB}	Byte 3 Sub-index	Byte 4 Value X_{LSB}	Byte 5 Value X_{MSB}	Byte 6 Don't care	Byte 7 Don't care
0x201	0x01	0x81	0x30	0x18	0xBC	0x02	0xFF	0xFF

The XDi-net setup commands above are broadcast to all XDi units on the CAN bus, therefore they will all be set up to use the same critical band values for the data type RPM instance 1.

NOTE: A DAM-MPDO (if activated) or an SDO may also be used to set the critical band parameters, but it will be a unit-by-unit setup, not a global setup. (If you use SDO, then remember to unlock first).

4 Product parameter setup via CAN

4.1 Manufacturer-specific object index

The whole backbone of the XDi is the manufacturer-specific section of the CANopen object index table. This makes it possible to control almost all key functions of the XDi via SDO communication on CAN. To protect the XDi configuration from unintentional parameter changes, the SDO communication is protected by a lock/unlock procedure.
The grouping of the manufacturer-specific sector from 0x2000 to 0x5FFF is illustrated in the table below:

XDi index 0x2000 – 0x5FFF	Max. # objects Instance	Object types	Note
0x2000 – 0x2FFF	4096	System and main control parameters	Only indexes in appendix must be accessed
0x3000 – 0x3FFF	4096	Variable XDi input/output data	Global parameters
0x4000 – 0x4FFF	4096	Product parameters	Specific for this XDi unit
0x5000 – 0x5FFF	4096	RESERVED/RESTRICTED	Must not be accessed

4.2 0x2000 parameters

Parameters in the 0x2000 group are system-specific parameters. Most of these parameters are not relevant for normal operation, setup, and control of an XDi system.
The relevant parameters in the 0x2000 group can be found in Appendix 2.

IMPORTANT: indexes that are not listed in the appendix must not be accessed or changed.

4.3 0x4000 parameters

Object indexes 0x4000 to 0x4FFF contain product-specific parameters like:

- Product type
- Software and hardware version
- Library information and version
- Selected virtual indicator and setup profiles
- Command for automated setup
- VI headline selection and text
- VI label selection and text
- VI unit selection

This type of control parameters can be used by a CAN controller to automatically configure the XDi during installation or afterwards in a service situation.

The list of relevant 0x4000 parameters is in

4.4 SDO write protection

It is only possible to change parameter values in the 0x2000 or 0x4000 sections in the object index table by using SDO communication, and since changes may seriously affect the operation of the XDi, the SDO write function is protected extra by a special lock and unlock function.

The lock (SDO write protection) is enabled by default. Before you write new data into an index/sub-index, it is required to unlock (disable the SDO write lock).

The unlock function has an adjustable timeout (default 5 seconds); if there is no SDO communication when the time runs out, the XDi will automatically lock the SDO write function again.

It is possible to change the automatic timeout from 1 to 65 sec.

Setting the timeout to 0 will disable the timeout function. In this case it is important to send a lock command when SDO communication is finalised.

IMPORTANT: It is not recommended to disable the automatic SDO write lock function, as this may leave the XDi open for accidental or unintentional changes of parameters.

NOTE: the protection does not affect the possibility to read indexes by using an SDO read request.

4.4.1 SDO write protection index

Index - sub	Description	Default value	
0x401F-01	Locking/unlocking of SDO write	0x80000000	0x7FFFFFFF: normal unlocked SDO write operation. 0x80000000: all manufacturer-specific object indexes (0x2000...0x5FFF) are blocked for SDO write operations (except the SDO protection object index 0x401F itself).
0x401F-02	SDO write protection timeout	5000	0: no timeout on SDO write operation. SDO write operation is only controlled by sub-index 0x01. >0: timeout in [ms]. When the time that has passed since the last successful SDO write exceeds the timeout, sub-index 0x01 is forced to: 0x80000000. Values 1...999 are forced to 1000, to ensure minimum 1 sec. timeout.

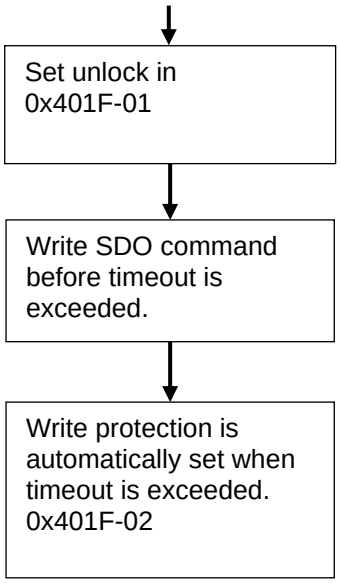
4.5 SDO write unlock procedure

Send the unlock code 0x7FFFFFFF to index 0x401F-01 by using SDO write.

Make the changes you want to make by using SDO read/write commands.

When you have finalised the SDO write communication with the XDi unit, it will still be open for accidental changes for another 5 seconds, before the automatic lock function will set the value of index 0x401F-01 to 0x80000000 (locked).

If a timeout longer that 5000 ms is needed, the timeout should be changed before unlock.



NOTE: To lock the XDi immediately after finishing SDO writing, you must send the lock command 0x80000000 to index 0x401F- 01. This is also the correct procedure to use if automatic activation of protection is disabled. you may at any time read the lock code in index 0x401F- 01 to determine whether the XDi is locked or not.

4.5.1 Examples of the SDO commands used

The Node-ID for the XDi in the following example: 0x79 (=121)

Read timeout value

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Read	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data value (LSB)	Data value (MSB)	Don't care	Don't care
0x679	0x40	0x1F	0x40	0x02	0x00	0x00	0x00	0x00

Response from XDi:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Resp.	Resp.	Resp.	Resp.
0x5F9	0x60	0x1F	0x40	0x02	0x60	0xEA	0x00	0x00

```
#6327 SD Tx 4328.713000 Id: 00000679, Length: 8, Data: 40 1F 40 01 00 00 00 00
#6328 SD Rx 4328.757000 Id: 000005F9, Length: 8, Data: 60 1F 40 02 60 EA 00 00
```

The timeout value is 0xEA60, equal to 60000 ms.

Change the timeout value

Change value to 0x0000, this will disable timeout.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Write	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data value (LSB)	Data value (MSB)	Don't care	Don't care
0x679	0x2B	0x1F	0x40	0x02	0x00	0x00	0x00	0x00

Response from XDi:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Resp.	Resp.	Resp.	Resp.
0x5F9	0x60	0x1F	0x40	0x02	0x00	0x00	0x00	0x00

```
#3289 SD Tx 1696.951000 Id: 00000679, Length: 8, Data: 2B 1F 40 02 00 00 00 00
#3290 SD Rx 1697.013000 Id: 000005F9, Length: 8, Data: 60 1F 40 02 00 00 00 00
```

Set SDO protection to unlock

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Write	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data value (LSB)	Data value	Data value	Data value (MSB)
0x679	0x23	0x1F	0x40	0x01	0xFF	0xFF	0xFF	0x7F

Data value: 0x7FFFFFFF.

Response from XDi:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Resp.	Resp.	Resp.	Resp.
0x5F9	0x60	0x1F	0x40	0x01	0xFF	0xFF	0xFF	0x7F

```
#4765 SD Tx 2088.503000 Id: 00000679, Length: 8, Data: 23 1F 40 01 FF FF FF 7F
#4766 SD Rx 2088.554000 Id: 000005F9, Length: 8, Data: 60 1F 40 01 FF FF FF 7F
```

Set SDO protection to lock

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Write	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data value (LSB)	Data value	Data value	Data value (MSB)
0x679	0x23	0x1F	0x40	0x01	0x00	0x00	0x00	0x80

Data value: 0x80000000.

Response from XDi:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Resp.	Resp.	Resp.	Resp.
0x5F9	0x60	0x1F	0x40	0x01	0x00	0x00	0x00	0x80

```
#5416 SD Tx 2261.362000 Id: 00000679, Length: 8, Data: 23 1F 40 01 00 00 00 80
#5417 SD Rx 2261.398000 Id: 000005F9, Length: 8, Data: 60 1F 40 01 00 00 00 80
```

Read SDO protection

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Write	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data value (LSB)	Data value	Data value	Data value (MSB)
0x679	0x40	0x1F	0x40	0x01	0x00	0x00	0x00	0x00

Read value for SDO protection.

Response from XDi:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Resp.	Resp.	Resp.	Resp.
0x5F9	0x43	0x1F	0x40	0x01	0x00	0x00	0x00	0x80

XDi response: 0x80000000 – SDO write is locked.

Locked:

```
#5827 SD Tx 2370.619000 Id: 00000679, Length: 8, Data: 40 1F 40 01 00 00 00 00
#5828 SD Rx 2370.680000 Id: 000005F9, Length: 8, Data: 43 1F 40 01 00 00 00 80
```

Unlocked:

```
#6200 SD Tx 4230.113000 Id: 00000606, Length: 8, Data: 40 1F 40 01 00 00 00 00
#6201 SD Rx 4230.168000 Id: 00000586, Length: 8, Data: 43 1F 40 01 FF FF FF 7F
```

Remember to use the correct COB-IDs to address a particular XDi identified by its Node-ID.

In chapters 5, 6, and 7, you will see an example, in which the XDi that is controlled via CAN is assigned Node-ID 6. In this case, the COB-ID to transmit is 0x606, and the response from the XDi will come in COB-ID 0x586.

5 Automated XDi start-up configuration via CANopen

It is possible to implement what we call a “base master” (BM) configuration function in a CANopen master or CAN controller (PLC) to automatically make system configuration of XDi units in a CAN bus system.

The only requirement is that each XDi is assigned a Node-ID and that the controller knows the configuration parameters for each node.

Node-ID is the first selection in the XDi start-up wizard, and when the Node-ID is selected, the XDi will send a message that it is on the bus and ready to be set up.

When this message is received, the controller should immediately take over and make the configuration via CAN.

The installer will not even see the rest of the steps in the wizard before the XDi boots up again with the automatically selected virtual indicator and setup profiles.

5.1 Automated configuration of a service device

Integrating automated configuration in your CAN controller will also open up easy service replacement of the XDi. A faulty XDi in a system can just be replaced by a new XDi unit, assigned the same Node-ID as the old faulty unit. Now the CAN controller can take over and configure the new service unit via CAN.

An XDi from a non-critical location can also be used as a replacement unit, if an XDi at a more critical location is faulty. Just perform a master reset to factory settings, and it will be as good as new.

Remember: write the Node-ID number on the label behind the front frame on all XDi units in the system. The Node-ID is then easily available in a service situation.

5.2 Fully automated setup after replacement of a faulty XDi

The scenario is that the technician on board replaces a faulty XDi with an XDi in “service unit mode”.

Any XDi can be brought into “service unit mode” simply by making a master reset to “service unit”.

In this mode the XDi is “parked” on the service node (Node-ID 127) and reset to factory settings, and the start-up wizard is shown. In addition, it sends heartbeat (must be active) to indicate its presence on the CAN bus.

The BM controller monitors all XDi units on the CAN bus by their heartbeat and detects that the replaced XDi Node is no longer available, but a service unit is present on Node127.

The BM controller is now able to shift the Node-ID of the “XDi service unit” to the Node-ID that was detected to be lost. The Node-ID shift is performed using CANopen LLS procedure, and immediately after the controller makes the automated configuration of the new XDi service device.

Replacement of one faulty unit can be fully automatic; if more than one unit is missing on the CAN bus, the installer may have to decide the order of replacement.

5.3 Procedure for automated indicator setup

When an XDi is installed in a CAN network and powered up the first time, the start-up wizard will automatically start and ask for a Node-ID. As soon as the Node-ID is assigned, the XDi will send an emergency message on CAN:

Alarm type	**When**	**Duration**	**Error register Obj. in 0x1001**	**Emergency error code**	**CAN manufacturer-specific error code in EMCY**	
					Warning Byte 3	Alert Byte 4
Emergency	Setup wizard is active and Node-ID is assigned	While setup wizard is active	0x81	0xFF00	0xFF	0xFF

When a CAN master or CAN controller detects this message on the CAN bus, it can start an auto-configuration process as follows:

- Read 0x1018, sub-index 0x01 to verify that the vendor ID is DEIF: 0x0000B2 and that the DPM code is 0x10 (standard XDi-net product). Then read sub-index 0x02 to verify that it is the correct XDi size (for example 0x02 = XDi144) and performance class (0x00 = Single, 0x01 = Dual, 0x02 = Multi).
- If 1) is OK, read index 0x4001, sub-indexes 0x02, 0x03, 0x05 and 0x07 to verify that the XDi contains the correct library.
- If 2) is OK, unlock the XDi for SDO write (see unlock procedure).
- If the XDi is mounted upside down, send value 0x01 to the 180o rotation index 0x400B-04. This must be done even if the XDi starts up in “upside down mode”. (You may also rotate the display presentation manually after setup, or later via the user menu).
- Write the desired VI, VS and PP numbers to the XDi in index 0x4007-01(configuration command).
- The XDi will reboot and start up in normal mode with the desired indicator setup.

To verify setup from the CAN controller:

- Wait until heartbeat is received from the XDi after boot-up.
- Read 0x4007-01, if it reads 0x00000000 the setup process was successful.
  If it reads 0xFFFFFFFF, the configuration has failed, for example because the selected PP, VI or VS does not exist. (If it reads the same configuration that you just sent, it is because you have not changed anything and the XDi has not rebooted either.)
- If 8) is OK, you may read the active VI number in 0x4002-02, the active VI setup number in 0x4002-11 and the active product profile number in 0x4003-02 and compare the result with the desired selection made in 5).
- If 9) is OK, the setup is successfully completed.
- The lock function (SDO write protection) will activate automatically after timeout (or you can send the lock command to terminate timeout).

5.3.1 Overview of object indexes used for auto configuration

Index Sub-index	Object description	Obj. code Data type	Acc.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x4001	Installed XDi library	REC			
0x01	Reserved				
0x02	LIB owner ID number	U32	ro	Ex-SDO	Range: 0-4294967294 DEIF standard: 000000
0x03	LIB number	U32	ro	Ex-SDO	Lib. number is allocated to each LIB owner Range: 1-4294967294 Value 0x0…00 indicates that no LIB is loaded
0x04	LIB name (UTF8) (short name)	Visible string	ro	SDO	Max. 20 characters in the library name 0xF…FFFFFFF = Reserved
0x05	LIB version	U32	ro	Ex-SDO	The lib. version is a number starting at 1 and incremented by one* every time a library is approved and released for production
0x06	LIB revision	U32	ro	Ex-SDO	Library revision reference (Only relevant for test libraries)

Index Sub-index	Object description	Obj. code Data type	Acc.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x07	LIB status	U8	ro	Ex-SDO	Library status 0x00: DRAFT 0x01: approved by DEIF/customer
0x4002	Virtual indicator and VI setup selection	REC			
0x01	Total number of virtual indicators in LIB	U16	ro	Ex-SDO	Normally up to 100 VIs in one LIB Range: 1-65534 0 indicates that no VIs are available in LIB 0xFFFF is reserved
0x02	Active virtual indicator number	U16	rw	Ex-SDO	
	Virtual indicator setup:				
0x10	Total number of VI setup (VS) files for the active VI	U16	ro	Ex-SDO	Normally max. 50 VI setups for one virtual indicator Range: 1-65534 0 indicates that no VI setup is available in the LIB 0xFFFF is reserved
0x11	Active VI setup (VS) file number	U16	rw	Ex-SDO	
0x4003	Product profile:	REC			
0x01	Total number of product profiles (PP) in this LIB	U16	ro	Ex-SDO	Normally max. 50 product profiles in one XDi LIB Range: 1-65534 0 indicates that no PP is available in LIB 0xFFFF is reserved
0x02	Active PP file number	U16	rw	Ex-SDO	
0x4007	OD status handling				
0x01	Select indicator and setup	U32	wo	Ex-SDO	Setup PP (product profile), VI (virtual indicator) and VS (virtual indicator setup) Byte 0: VS 1-255 Bytes 1-2: VI 1-65535 Byte 3: PP 1-255 Value will be set to command status when the command has been executed (after less than 30 seconds) Command status: 0xFFFFFFFF: ERROR 0x00000000: idle (new setup has been executed) 0xXXYYYYZZ: setup not changed (XX = old VS, YYYY = old VI, ZZ = old PP. XDi already has this setup)
....					

Index Sub-index	Object description	Obj. code Data type	Acc.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x400B	Product sound and display setup				
...					
0x04	Display rotation Normal/up-side down	U8	rw	Ex-SDO	0x00 = Normal 0x01 = Up-side down (rotated 180 deg.) Rest is reserved

5.4 Example - automated configuration via CAN

An XDi 144 Multi is powered up for the first time on the CAN bus with a CAN controller (Node-ID 1) with automatic configuration.

The installer has selected Node-ID: 6 (0x06) in the first step of the XDi start-up wizard.

Immediately after, the XDi sends out an emergency message on CAN, indicating that Node-ID: 0x06 is on the bus, but not configured.

5.4.1 Emergency message – XDi is not set up

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x080+ Node-ID	Emrg. Error code (LSB)	Emrg. Error code (MSB)	Error register	Manuf. spec.	Manuf. spec.	Manuf. spec. (Not used)	Manuf. spec. (Not used)	Manuf. spec. (Not used)
0x086	0x00	0xFF	0x81	0xFF	0xFF	0x00	0x00	0x00

On receipt of this message, the CAN controller (Node-ID 1) takes over.

The controller has the configuration for Node-ID 6 stored:

- The XDi at node 6 must be set up to use: PP 02, VI 014 and VS 03
- XDi must be type: XDi 144 (size 0x02) and type Multi (performance type 0x03)
- XDi must have a pre-loaded library identified by: owner: 400413 (0x061c1d), Lib. no. 02 version 100 (0x64)
- Library must be the approved version (the one released for production - not a draft library).

The CAN controller can now run the automated setup process using Expedited SDO communication.

In the following steps, use the SDO read procedure to read the indexes (0xWXYZ)/sub-indexes (0xTT):

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Read	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Res.	Res.	Res.	Res.
0x606	0x40	0xYZ	0xWX	0xTT	0x00	0x00	0x00	0x00

1. Read index 0x1018, sub-index 0x01 using SDO exp. upload:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Read	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Res.	Res.	Res.	Res.
0x606	0x40	0x18	0x10	0x01	0x00	0x00	0x00	0x00

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Read response	Obj. index (LSB)	Obj. index (MSB)	Sub-ndex	Data (LSB) Vendor ID (LSB)	Data Vendor ID	Data Vendor ID (MSB)	Data (MSB) DPM code
0x586	0x43	0x18	0x10	0x01	0xB2	0x00	0x00	0x10

```
#10940 SD Tx 3838.045000 Id: 00000606, Length: 8, Data: 40 18 10 01 00 00 00 00
#10941 SD Rx 3838.107000 Id: 00000586, Length: 8, Data: 43 18 10 01 2B 00 00 10
```

Now verify that the vendor ID is DEIF: 0x0000B2 and that the DPM code is 0x10 (standard XDi-net product).

Then read sub-index 0x02:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Read response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data (LSB) Product (XDi size)	Data Perform. class	Data Reserved	Data (MSB) Reserved
0x586	0x43	0x18	0x10	0x02	0x02	0x02	0x00	0x00

```
#26221 SD Tx 9130.324000 Id: 00000606, Length: 8, Data: 40 18 10 02 00 00 00 00
#26222 SD Rx 9130.372000 Id: 00000586, Length: 8, Data: 43 18 10 02 02 02 00 00
```

Now verify that it is the correct XDi size and performance class: 0x02 = XDi144 and performance class 0x02 = Multi.

1. Read index 0x4001, sub-index 0x02, 0x03, 0x05 and 0x07:
   To verify that the XDi contains the correct library:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Read response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data (LSB) Library owner	Data Library owner	Data Library owner	Data (MSB) Library owner
0x586	0x43	0x01	0x40	0x02	0x1D	0x1C	0x06	0x00

```
#29409 SD Tx 10761.755000 Id: 00000606, Length: 8, Data: 40 01 40 02 00 00 00 00
#29410 SD Rx 10761.803000 Id: 00000586, Length: 8, Data: 43 01 40 02 1D 1C 06 00
```

Library owner is 0x061C1D = 400413 – OK.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Read response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data (LSB) Library number	Data (MSB) Library number	Reserved	Reserved
0x586	0x43	0x01	0x40	0x03	0x02	0x00	0x00	0x00

```
#30530 SD Tx 11331.417000 Id: 00000606, Length: 8, Data: 40 01 40 03 00 00 00 00
#30531 SD Rx 11331.461000 Id: 00000586, Length: 8, Data: 43 01 40 03 02 00 00 00
```

Library number is 0x000002 – OK.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Read response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data (LSB) Library version	Data Library version	Data Library version	Data (MSB) Library version
0x586	0x43	0x01	0x40	0x05	0x64	0x00	0x00	0x00

```
#31406 SD Tx 11564.276000 Id: 00000606, Length: 8, Data: 40 01 40 05 00 00 00 00
#31407 SD Rx 11564.332000 Id: 00000586, Length: 8, Data: 43 01 40 05 64 00 00 00
```

Library version is 0x000064 (= 100) – OK.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Read response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data (LSB) Library status	Res.	Res.	Res.
0x586	0x4F	0x01	0x40	0x07	0x01			

```
#34918 SD Tx 12496.574000 Id: 00000606, Length: 8, Data: 40 01 40 07 00 00 00 00
#34919 SD Rx 12496.632000 Id: 00000586, Length: 8, Data: 4F 01 40 07 01 00 00 00
```

Library status is 0x01 = approved (= released) – OK.

All preconditions are OK to continue the setup process:

a) Unlock the XDi for SDO write (see description in chapter “SDO write unlock procedure”).

b) If the XDi is mounted upside down, write the 180° rotation command 0x01 to 0x400B-04:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Write	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data (LSB) Line no.	Don’t care	Don’t care	Don’t care
0x606	0x2F	0x0B	0x40	0x04	0x01	-	-	-

NOTE: must always be sent if the XDi is mounted upside down.

3. Write the desired VI, VS and PP numbers in the configuration command, index 0x4007-01:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Write	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data (LSB) VS	Data VI (LSB)	Data VI (MSB)	Data (MSB) PP
0x606	0x23	0x07	0x40	0x01	0x01	0x09	0x00	0x01

PP 01 (0x01), VI 009 (0x0009) and VS 01 (0x01).

4. The XDi will reboot and start up with the selected settings.

It may take several seconds before the reboot and setup are finalised and the XDi can return the status command.

(The XDi will make 3 beeps when it is up and running again).

5. Listen for heartbeat from Node 6 – when heartbeat is received, you can continue.

6. Verify that configuration was successful:

To verify that the setup is performed correctly. Read 0x4007-01 = setup has been executed, or 0xFFFFFFFF = setup has failed, for example the selected PP, VI or VS may not exist.

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Read response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data (LSB)	Data	Data	Data (MSB)
0x586	0x43	0x07	0x40	0x01	0x00	0x00	0x00	0x00

Status is **0x00000000**: setup is successfully completed.

Status: 0xFFFFFFFF = setup has failed, for example the selected PP, VI or VS does not exist.

NOTE: If you write the configuration command with the exact same selection of VI, VS and PP as the XDi is already configured to use (= no change), it will not reboot, and when reading 0x4007-01, the response will be exactly the VI, VS and PP that were just written (not the command status: 0x00000000 or 0xFFFFFFFF).

7. If the previous point was OK, read and verify the active VI, VS and PP numbers:
   7.1 Read the number of the active VI in 0x4002-02

XDi response:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Read response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data VI no. (LSB)	Data VI no. (MSB)	Res.	Res.
0x586	0x4B	0x02	0x40	0x02	0x09	0x00		

Test parameter: VI 9

```
#19368 SD Tx 7865.837000 Id: 00000606, Length: 8, Data: 40 02 40 02 00 00 00 00
#19369 SD Rx 7865.896000 Id: 00000586, Length: 8, Data: 4B 02 40 02 09 00 00 00
```

   7.2 Read the active VI setup number in 0x4002-11

Response:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Read response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data VI no. (LSB)	Data VS no. (MSB)	Res.	Res.
0x586	0x4B	0x02	0x40	0x11	0x01	0x00		

Test parameter: VS 1

```
#20396 SD Tx 8209.633000 Id: 00000606, Length: 8, Data: 40 02 40 11 00 00 00 00
#20397 SD Rx 8209.681000 Id: 00000586, Length: 8, Data: 4B 02 40 11 01 00 00 00
```

   7.3 Read the active product profile number in 0x4003-02

Response:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x580+ Node-ID	Read response	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data PP no. (LSB)	Data PP no. (MSB)	Res.	Res.
0x586	0x4B	0x03	0x40	0x02	0x01	0x00		

Test parameter: PP 01

```
#20824 SD Tx 8352.536000 Id: 00000606, Length: 8, Data: 40 03 40 02 00 00 00 00
#20825 SD Rx 8352.599000 Id: 00000586, Length: 8, Data: 4B 03 40 02 01 00 00 00
```

8. Setup is verified and OK: PP 01 (0x01), VI 09 (0x09) and VS 01 (0x01)
   The setup is successfully completed.

9. The lock function (SDO write protection) will automatically lock again after timeout period
   (If you have disabled timeout, you must write the lock command now that the setup is completed).

6 Changing headline on a virtual indicator via CAN

Headlines, labels and units are located in the index range 0x4100 to 0x414F.
Index numbers for max. 15 headlines, 31 labels and 31 units are allocated, each with a text list of up to 32 fixed text lines and 32 custom text lines.

6.1 Changing headlines on a virtual indicator

If the selected virtual indicator design includes a “selectable headline”, there will always be one default headline text selected in the VI setup (VS) that also contains the complete fixed headline list.

It is possible to substitute that headline with another one from the fixed headline list stored in the VS.
The headline list may contain up to 32 pre-defined fixed headlines and, in addition, 32 new “empty” custom text lines that may be used for new tests, these can be entered either via CAN or manually from the XDi virtual keyboard in the installation menu.

When automatic configuration via CAN is used in a system, it will often be necessary to select a new headline (for example change from rudder to rudder PS) via CAN.

The headline shift via CANopen can be a new selection of one of the up to 32 pre-defined text lines.
Alternatively, it could be a transfer of a new text line into one of the 32 “new text lines” and then selection of this line.
NOTE: it is of course always possible to select and enter headlines, labels or units manually via the XDi installation menu.

6.1.1 Select new headline from pre-defined text list

The CAN controller must know the pre-programmed headlines that are to be used in the installation. They can be found in the library specification document, and it is also possible to read the pre-defined test lines from the XDi index table.

The text list for headline 1 is located in index 0x4101 (headline 2 list is in 0x4102…headline 15 list is in 0x410F).

In index 0x4101, the fixed pre-defined text lines are located in sub-index 0x10+line number, that is in the range: 0x11 to 0x30 (32 lines), and the first empty “new lines” are located from sub-index 0x31 and up to 0x50 (32 lines).

The actual selected headline number can be read from sub-index 0x01, using SDO communication.

Remember to unlock SDO write before you write a new line selection.

To select a new headline 1 from the fixed selection list, write the new line number to index 0x4101-01.

The value must be in the range 0x11 to 0x30 for fixed headlines.

Example: select fixed headline no. 4 by sending 0x14 to the XDi with Node-ID: 0x06

1. Unlock SDO write
2. Send SDO

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Write	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data (LSB) Line no.	Don’t care	Don’t care	Don’t care
0x606	0x2F	0x01	0x41	0x01	0x14	-	-	-

```
#3718 SD Tx 4529.586000 Id: 00000606, Length: 8, Data: 2F 01 41 01 14 FF FF FF
#3719 SD Rx 4529.648000 Id: 00000586, Length: 8, Data: 60 01 41 01 14 00 00 00
```

It may take a few seconds before the new headline is shown on the XDi display.

NOTE: The number of available pre-defined fixed headlines is located in sub-index 0x03. You can read sub-index 0x03 to make sure that you do not select a number that is not available. The largest value you can send to index 0x4101 sub-index 01 is: 0x10 +“value in sub-index 0x03”.

6.1.2 Write new custom headline text to the XDi and select it

New custom headlines can be written in the index range 0x4101-31 (0x31 is the first custom text line) to 0x4101-50 (32 lines in total). The text format is UTF8 (Unicode type with variable length characters).

Reading and writing text to these indexes requires implementation of SDO block upload and download in the CAN controller that makes the automatic setup via CAN.

It is recommended to use a CAN management tool or software module for this operation.

For testing, DEIF engineers have used “Device Manager software”.

Remember to unlock SDO write.

Start writing the first custom headline in sub-index 0x31, max. length is 32 characters. In in practice, the max. length depends on the space available for headline text in the VI design.

Always use the next available sub-index when you write a new headline into the list.

For example, if “custom text 1” is located in index 0x4101-31, then “custom text 2” must be located in 0x4101-32.

It is possible to overwrite an existing text line in the sub-index range 0x31 to 0x50.

Important when reading and writing text strings

Note 1: reading a text string from an XDi using SDO will always return 44 bytes, the actual text string followed by the “end of string character” 0x00.

Note 2: text in a write text string must be followed by the “end of string character” 0x00

Note 3: if you receive an error when writing short texts, it is recommended to write a minimum of 4 characters (fill up with spaces) to avoid this. This applies to all text strings in the XDi.

6.1.3 Make custom headline visible in the XDi menu

To make the new custom headline in index 0x4101-31 visible in the XDi menu for headline selection (recommended), it is necessary to set the number of new text lines to 1 in index 4101-04.

The default value is 0.

Every time a new custom text line is added, index 0x4101-04 must be incremented by one - the value informs the XDi menu system of the available number of custom headlines.
For example, if two custom headlines are added in index 0x4101-31 and 0x4101-32 respectively, then write the value 0x02 in index 0x4101-04.

If 0x4101-04 is updated as described, the largest available custom headline number is 0x30 + value in sub-index 0x04.

6.1.4 Select custom headline to be visible on the virtual indicator

To make the new customer headline text in index 0x4101-31 visible on the virtual indicator, write the line number 0x31 to index 0x4101-01.

To select custom headline 2, index 0x4101-32, write 0x32 to 0x4101-01, and so on.

6.2 Change labels or units on a virtual indicator

The principles described in the previous section also applies if selectable labels or units are designed into a virtual indicator. (Note that unit is only a text string and can only be another representation of the unit on the indicator, for example RPM can be changed to 1/min).

The variable labels are located in index 0x4110 to 412F (max. 31 different labels can be defined in one virtual indicator, each with a text list as described for headlines).

The variable units are located in index 0x4130 to 414F (max. 31 different units).

The maximum length of a text string for labels and units is 20 characters, but in practice, again, it is limited to the space provided in the virtual indicator design.

7 Rotate the display presentation 180° via CAN

The display orientation may be rotated 180° via CAN, using SDO communication.

1. Unlock the XDi for SDO write (see description in chapter “SDO write unlock procedure”).
2. If the XDi is mounted upside down, write the 180° rotation command 0x01 to 0x400B-04:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Write	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data (LSB)	Don’t care	Don’t care	Don’t care
0x606	0x2F	0x0B	0x40	0x04	0x01	-	-	-

3. Save the new value immediately by sending the save command in index 0x1010-04:

COB-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x600+ Node-ID	Write	Obj. index (LSB)	Obj. index (MSB)	Sub-index	Data (LSB)	Data	Data	Data (MSB)
0x606	0x23	0x10	0x10	0x04	0x73	0x61	0x76	0x65

This is equal to ASCII: **“Save”**.

The display presentation will rotate and this setting is saved. (The XDi will periodically make an auto-save).

8 Error and fault messages

The XDi supports the CANopen emergency message. In addition to the mandatory messages required by CANopen, a number of manufacturer-specific warnings and alerts are added.

8.1 Warnings and alerts

No valid CAN data on the bus
CAN data lost
Power supply drop-out, or low

The details are described in Appendix 5 - XDi error and fault indication.

APPENDIX

9 Appendix 1 - CANopen standard object dictionary

The following describes the CAN settings for an XDi indicator, RC20 or UC20.

9.1 Object 0x1000 device type (mandatory)

Access	ro
PDO mapping	No
Value range	Unsigned 32
Default value	No

MSB LSB

Additional info (16b)	Device profile (16b)
0x0000	0x0000

9.2 Object 0x1001 error register

Access	ro
PDO mapping	No (optional)
Value range	Unsigned 8
Default value	No

Single bit field requirements according to standard

MSB LSB

7	6	5	4	3	2	1	0
O	O	O	O	O	O	O	M

O = optional, M = mandatory

XDi-net support:

Bit	Supported	Content
0	Yes	generic error
1	No	current
2	No	voltage
3	No	temperature
4	No	communication error (overrun, error state)
5	No	device profile specific
6	No	Reserved (always 0)
7	Yes	manufacturer specific

Supported errors: Generic error: 0x01
Manufacture: 0x81

This index is sent in the emergency object EMCY (0x080+Node-ID) if an error occurs.
When the error situation is cleared, “Reset error/No Error” is sent in the same EMCY object.
Emergency Object (EMCY):

Byte	0	1	2	3	4	5	6	7

Content	Emergency Error Code (table 21 in the CANopen CiA 301 standard)	Error register (Object 1001H)	Manufacturer specific Error Field

See section: "**XDi error and fault indication**" for details about error codes and "manufacturer-specific error codes" sent in the event of an error.

9.3 Object 0x1008 manufacturer device name (USED - optional)

Contains the XDi device name

INDEX	1008h
Name	manufacturer device name
Object Code	VAR
Data Type	Visible String
Category	Optional

Access	Constant
PDO mapping	No
Value range	No
Default value	No

Maximum string length in XDi-net: 20 characters

Device name example: XDi 192M

9.4 Object 0x100A manufacture software version (USED - optional)

This field contains the console application software version of the XDi.

The manufacturer-specific index: 0x4000, sub-index 10..., 20..., 30... contains versions of additional software modules contained in the XDi.

INDEX	100Ah
Name	manufacturer software version
Object Code	VAR
Data Type	Visible String
Category	Optional

Access	Constant
PDO mapping	No
Value range	No
Default value	No

Format: Software version X.YZ.V (for example 1.23.4) represented as ASCII figures.

9.5 Object 0x100C guard time (conditional)

Condition: Is used if heartbeat is turned off

INDEX	100Ch
Name	Guard time
Object Code	VAR
Data Type	Unsigned 16
Category	Conditional: Mandatory if heartbeat is not supported

Access	rw ro, if life guarding is not supported
PDO mapping	No
Value range	Unsigned 16
Default value	0

9.6 Object 0x100D lifetime factor (conditional)

Condition: is used if heartbeat is turned off

INDEX	100Dh
Name	Lite time factor
Object Code	VAR
Data Type	Unsigned 8
Category	Conditional: Mandatory if heartbeat is not supported

Access	rw ro, if life guarding is not supported
PDO mapping	No
Value range	Unsigned 8
Default value	0

9.7 Object 0x1010 store parameters (USED - optional)

In general, XDi parameters are stored directly in RAM memory when received.

This function is used:

1. In connection with LLS protocol, to save critical parameters to non-voluntary memory, for example if Node-ID is changed using LLS.
2. To force the XDi to immediately save data from RAM to FLASH.

NOTE: To reduce SAVE cycles to flash memory and thereby increase lifetime of the flash memory, the XDi has a periodical save function approximately every 10 seconds. This means that if a parameter is changed and power is interrupted right after, the change may be lost.

INDEX	1010h
Name	Store parameters
Object Code	Array
Data Type	Unsigned 32
Category	Optional

SAVE function supported:

READ the device storage functionality of the device by:

Unsigned 32:

MSB		LSB
31-2	1	0
Reserved (=0)	0/1	0/1

Bit sequence

Bit no.	Value	Description
31-2	0	Reserved (=0)
1	0 1	Device does not save parameters autonomously Device saves parameters autonomously
2	0 1	Device does not save parameters on command Device saves parameters on command

SAVE command: the device to store parameters or data:

MSB			LSB
e	v	a	s
65h	76h	61h	73h

This is equal to ASCII: **“save”**.

Sub-index	0x00
Description	Largest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	0x01-7F
Default value	No

Sub-index	0x01
Description	Save all parameters
Entry category	Mandatory
Access	rw

PDO mapping	No
Value range	Unsigned 32 (see r/w format above)
Default value	No

9.8 Object 0x1011 restore default parameters (USED - optional)

This function is used to restore the factory settings. It is equal to making a manual master reset to factory settings.

INDEX	1011h
Name	Restore default parameters
Object Code	Array
Data Type	Unsigned 32
Category	Optional

Restore function supported:

READ the device storage functionality of the device by:

Unsigned 32:

MSB	LSB
31-1	0
Reserved (=0)	0/1

XDi-net devices support the restore function, bit 0 = 1 .

RESTORE command:

MSB			LSB
D	A	O	l
64h	61h	6Fh	6Ch

This is equal to ASCII: **“load”**.

Sub-index	0x00
Description	Largest sub-index supported
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	0x01-7Fh
Default value	No

Sub-index	0x01
Description	Restore all default parameters
Entry category	Mandatory

Access	rw
PDO mapping	No
Value range	Unsigned 32 (**load**)
Default value	No

This is the XDi “Factory reset” command.

9.9 Object 0x1014 COB-ID emergency message

Emergency Object (EMCY):

Byte	0	1	2	3	4	5	6	7
Content	Emergency Error Code (table 21 in the CANopen CiA 301 æstandard)		Error register (Object 1001H)	Manufacturer specific Error Field				

XDi-net only supports 11 bit COB-ID, bit 29 in the CAN frame is “0”
Bit 31 indicates if EMCY exists/is valid or not: “0”= exists/valid

INDEX	1014h
Name	COB-ID Emergency message
Object Code	VAR
Data Type	Unsigned 32
Category	Conditional: Mandatory if Emergency is supported

Access	rw
PDO mapping	No
Value range	Unsigned 32
Default value	80h+Node-ID

9.10 Object 0x1016 consumer heartbeat time (USED - optional)

XDi products are able to work as a heartbeat consumer in all CAN modes, if heartbeat is turned on.
It is always on in XDi-net and in redundant CAN mode.
The heartbeat consumer time is by default 1.5 seconds (~ 3x producer time)

9.11 Object 0x1017 producer heartbeat time (USED - conditional)

In XDi-net, the cycle time of heartbeat is default set to 500 ms for all XDi units; this is to keep track of active nodes on the network.

INDEX	1017h
Name	Producer heartbeat time
Object Code	VAR
Data Type	Unsigned 16
Category	Conditional: Mandatory if guarding is not supported

Access	rw
PDO mapping	No
Value range	Unsigned 16
Default value	500ms

9.12 Object 0x1018 identity object (mandatory)

The object at index 0x1018 contains general information about the XDi-net device.

Sub-index 0x01: the vendor ID contains the unique manufacturer ID.

Sub-index 0x02: the manufacturer-specific product code identifies a specific device version.

Sub-index 0x03: the manufacturer-specific revision number consists of a major revision number and a minor revision number.

The major revision number identifies a specific XDi-net/CANopen behaviour.

If the XDi-net/CANopen functionality is expanded or changed significantly, so that it is no longer compatible with older versions, the major revision will be increased by one.

The minor revision number identifies different versions with the same XDi-net/CANopen behaviour, those protocols are backward compatible, but may not include all functionality if interfacing with an XDi unit with an earlier minor revision.

Sub-index 0x04: the manufacturer-specific serial number identifies a specific device.

INDEX	1018h
Name	Identify Object
Object Code	Record
Data Type	Identity
Category	Mandatory

Sub-index	0x0
Description	No. of entries
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	1..4
Default value	No

9.12.1 Vendor ID

Sub-index	0x01
Description	Vendor ID
Entry category	Mandatory
Access	ro
PDO mapping	No
Value range	Unsigned 32

Default value	DEIF vendor ID

The vendor ID consists of:

31 24	23 0
Department (DPM)	Company (CompID)

Vendor number and department number are both assigned by CiA.
CANopen vendor ID (U24): CompID = 0x0000B2 DEIF
Department (DPM) (U8):
DPM=0x10 DEIF Bridge department - standard XDi-net products
DPM=0x11 DEIF branded OEM Bridge product (typically a sensor) where DEIF CANopen vendor ID is implemented

IMPORTANT: DEIF vendor ID and DPM = 0x10 may be used to identify an XDi unit from other types of CAN devices.

All undefined DPM numbers are considered not valid.

9.12.2 Product code

Sub-index	0x02
Description	Product code
Entry category	Used (optional)
Access	ro
PDO mapping	No
Value range	Unsigned 32
Default value	No

Standard XDi-net product code format:

31 24	23 16	15 8	7 0
Reserved	Reserved	Type (byte 1)	Product (byte 0)
MSB		LSB	

Defined product codes for DPM=0x10

Product type	Product (byte 0)
Reserved	0x00
XDi96	0x01
XDi144	0x02
XDi192	0x03
	0x04

Performance type	Type (byte 1)
Single	0x00
Dual	0x01
Multi	0x02
	0x03
	0x04

NOTE: For DPM=0x11, the OEM may have their own definition.

9.12.3 XDi-net revision number

Sub-index	0x03
Description	XDi-net revision number
Entry category	Used (optional)
Access	ro
PDO mapping	No
Value range	Unsigned 32
Default value	No

Revision number structure:

31 16	15 0
Major revision number	Minor revision number
MSB	LSB

First major revision is 0x0001

First minor revision is 0x0001

9.12.4 Serial number

Sub-index	0x04
Description	Serial number
Entry category	Used (optional)
Access	ro
PDO mapping	No
Value range	Unsigned 32
Default value	No

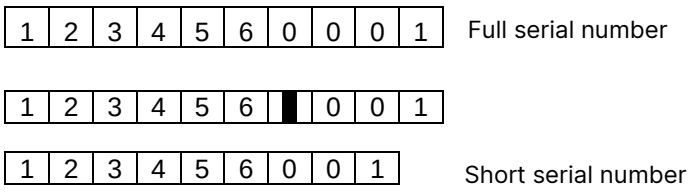
Serial number format:

The DEIF serial number consists of 6 digits + 4 digits. The first 6 digits are fixed for a manufacturing order of one or more XDi devices.

The last 4 digits are the serial number within this manufacturing order, which starts from 0001 in each new order.

To make the product serial number fit inside a 32-bit unsigned number, the first digit of the 4-digit serial number is removed and will not cause any problems, since the maximum order size is always less than 1000 XDi units.

Example:



The “short serial number” is stored as an unsigned 32 bit value.

10 Appendix 2 - data directory - XDi object index 0x2000-2FFF

The 0x2000 section of the manufacturer-specific object index is used for system and main control parameters.

10.1 Object 0x2000 self-starting device (optional)

Self-starting device is the ability to automatically enter operational state without an NMT command from a master.

Timeout period in index 0x2000 sub 0x00 defines the time, in which an NMT “change state command” is expected. If the period expires without such a command, the XDi will automatically enter operational state.

If the value of index 0x2000 sub-index 0x00 is set to zero, the device will stay in pre-operational mode and wait for an NMT command.

NOTE: if the “XDi-net functions” or “Auto-start XDi on the CAN bus” is set to ON in the XDi CAN bus settings, this object has no effect and the device will go directly from pre-operational state to operational state.

The default CAN settings are located in a product profile, and they can be changed from the CAN installation menu.

Object description

Index	0x2000
Name	Self-starting device time period
Object code	VAR*
Data type	Unsigned 16
Category	Optional

Entry description

Access	rw
PDO mapping	No
Default value	0x0001 (ms)
Lower limit	0x0000
Upper limit	0xFFFF
Unit	-

11 Appendix 3 - XDi object index 0x3000-3FFF

In the manufacturer-specified part of the CANopen object directory, the index sector from 0x3000 to 3FFF is called the "data directory" and is used to store and define the different variable input data types used by a virtual indicator.
The sub-indexes are used to describe in details the data type, value, resolution and parameters directly related to this data type (for example critical bands related to the actual data type).

The default setting of all used data types in an indicator are collected from the VI setup file. If setup parameters are changed via "Menu" or CAN, the corrected value is stored in the object index/sub-index and the sequence counter is increased by one.

11.1 Data type grouping/data type instance

The data directory contains a large number of data types (for example "Propeller RPM"), and each data type contains a group of the same type of data, but with different instance.
The group is called a "data type" with a reference index as header, and typically it consists of (additional) 15 indexes, all containing the same type of data but with a different instance.
They are called "data type instances" (or just "data instances"), each defined by their "instance number" (i#).
For example, the "Engine RPM" data type consists of a group of 16 indexes, where the first index 0x3200 (main index) contains general group information, and the rest represent RPM for engines 1 to 15, each assigned an RPM instance number (engine RPM-i#) .
In the VI setup (VS) each indicator source is preset to use a fixed data type and instance, this cannot be changed from the menu. But it is possible to define several VI setups with different instances.

11.1.1 Location of data type at a given instance in the data object index table

Data type number (main index) + instance number in the group, for example the index for RPM data from engine 5 is located in this object index: 0x3200+0x05= 0x3205.

NOTE: It is only in case that there is more than one of the same data type on the CAN bus that it is necessary to use different instances to separate data.

11.1.2 Pre-defined variable data indexes

XDi index	Max # objects Instance	Object types	Note
0x3000 – 0x3FFF	4096	Variable XDi input/output data	
0x3000-0x31FF	512	Propulsion	
0x3000-0x300F	16	Azimuth & Rudder	"-" = bow turns to port
0x3010-0x301F	16	Rudder%	"-" = bow turns to port
0x3020-0x302F	16	Pitch angle	"-" = astern
0x3030-0x303F	16	Pitch%	"-" = astern
0x3040-0x307F	64	Reserved	
0x3080-0x308F	16	Propeller RPM	"-" = astern
0x3090-0x309F	16	Propeller RPM%	"-" = astern
0x30A0-0x30AF	16	Propeller THRUST%	"-" = astern
0x30B0-0x30BF	16	Propeller POWER%	"-" = astern
0x30C0-0x30CF	16	Propeller LOAD%	
0x30D0-0x31FF	-	Reserved	
0x3200-0x33FF	512	Engine data	
0x3200-0x320F	16	Engine RPM (eng. 1-15)	"-" = reverse, astern
0x3210-0x321F	16	Engine RPM%	"-" = reverse, astern

XDi index	Max # objects Instance	Object types	Note
0x3220-0x322F	16	Engine THRUST%	“-“ = reverse, astern
0x3230-0x323F	16	Engine POWER%	“-“ = reverse, astern
0x3240-0x324F	16	Engine LOAD%	“-“ = reverse, astern
0x3250-0x329F	80	Reserved	
0x32A0-0x32AF	16	Engine fuel consumption	
0x32B0-0x32BF	16	Engine fuel consumption%	
0x32C0-0x32FF	64	Reserved	
0x3300-0x330F	16	Pressure type 1 (eng. 1-15)	
0x3310-0x331F	16	Pressure type 2 (eng. 1-15)	
0x3320-0x337F	96	Reserved	
0x3380-0x338F	16	Temperature type 1 (eng. 1-15)	
0x3390-0x339F	16	Temperature type 2 (eng. 1-15)	
0x33A0-0x33FF		Reserved	
0x3400-0x34FF	256	Electrical	
0x3400 - 340F	16	Electrical power AC1	
0x3410 - 341F	16	Electrical power AC1%	
0x3420 - 342F	16	Electrical power AC2	
0x3430 - 343F	16	Electrical power AC2%	
0x3440 - 345F	32	Reserved	
0x3460 - 346F	16	Voltage AC1	
0x3470 - 347F	16	Voltage AC2	
0x3480 - 348F	16	Voltage DC	
0x3490 - 349F	16	Current AC1	
0x34A0 – 34AF	16	Current AC2	
0x34B0 – 34BF	16	Current DC	
0x34C0-0x34CF	16	Frequency A	
0x34D0-0x34DF	16	Frequency B	
0x34E0-0x34EF	16	Insulation resistance AC	
0x34F0-0x34FF	16	Insulation resistance DC	
0x3500-0x351F	16	Dimmer	
0x3500-0x350A	11	Dimmer group 1 to 9 (dimmer and indicator day/night colour)	
0x350B-0x351F	-	Reserved	

XDi index	Max # objects Instance	Object types	Note
0x3520-0x353F	32	Reserved	
0x3540-0x354F	32	XDi-net “global” flags	
0x3540-0x354F	32	16 bit flag group (U16)	
0x3550-0x35FF	96	Reserved	
0x3600-0x36FF		Reserved	
0x3700-0x37FF	256	Universal data (7 instance groups)	
0x3700-0x3707	8	Universal data group 0 (I16)	Default resolution 0.1
0x3708-0x370F	8	Universal data group 1 (I16)	Default resolution 0.1
0x3710-0x3717	8	Universal data group 2 (I16)	Default resolution 0.1
0x3718-0x371F	8	Universal data group 3 (I16)	Default resolution 0.1
0x3720-0x3727	8	Universal data group 4 (I16)	Default resolution 1
0x3728-0x372F	8	Universal data group 5 (I16)	Default resolution 1
0x3730-0x3737	8	Universal data group 6 (I16)	Default resolution 1
0x3738-0x373F	8	Universal data group 7 (I16)	Default resolution 1
0x3740-0x37FF	192	Reserved for “7 instance groups”	
0x3800-0x38FF	256	Reserved	
0x3900-0x3AFF	512	Navigation data (TBD)	
0x3900-0x3907	8	Speed through water (longitudinal)	“-“ = reverse, astern and unit is knot
0x3908-0x3AFF	504	Reserved for “7 instance groups”	
0x3B00-0x3FFF	-	Reserved	

11.2 Appendix 3.1 - general rules for XDi variable data and parameters

Data specified in the XDi object directory as variable actual data (for example propeller RPM) is always located in sub-index 0x02, the fixed data resolution is located in sub-index 03 and it has a defined valid data range depending on the data type format (for example I16).

If the data type also contains a set point value (commanded value), this value will be located in sub-index 0x07, and its resolution is stored in 0x08.

The positive data range is limited to the max. positive value minus 2, and for “signed” data (integer) the largest negative signed value is limited to max. negative value plus one.

For example, if the data type is using the full range of a 2 byte “I16” field, the valid value range is -32767 to +32765 [0x8000 (-32768) and 0x7FFE (32766) and 0x7FFF(32767) are reserved for error indication].

This applies to all variable data or parameters, if nothing else is specifically defined.

11.2.1 Indicator source data via CAN bus

The virtual indicator in an XDi unit is collecting its input data from the pre-defined location in the object index table, where data is stored as an absolute (or %) value defined by the integer and a resolution defined for the data type.

Example:
propeller RPM1 at index 0x3081-02 contains the integer 1000, and the index 0x3081-03 contains the resolution value -1, this means that the absolute value to be indicated is:

$1000x10^{-1}$ = 100 RPM.

Note 1: The resolution is a fixed resolution pre-defined for each data type (for example propeller RPM) in the object index table. This table is stored in the XDi library and must be the same for all indicators that share data via the CAN bus network.

11.3 Appendix 3.2 - input data structure in the XDi data directory

All variable data is located in a “data type group” in the “data directory”. Data can either be an absolute data value or a relative % value.

The “data directory” is located in index 0x3000 - 0x3FFF, and all data is stored following a standard index and sub-index structure.

Each data type can have up to 15 instances (for example propeller RPM instance 1, 2, 3,...., 15), which identify several individual data sources delivering this type of data.

Variable data broadcast on XDi-net or received via a DAM-MPDO is identified by its object index and sub-index. Actual data is sent in sub-index 0x02 and if it is a set point (commanded) value in sub-index 0x07.

11.3.1 Object index structure for all variable data types

All XDi variable data types are defined as the examples in the table below for the azimuth angle data type.

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O	Default COB-ID/Com. obj	Note
0x3000	Data group def.						This describes the parameters for each instance in a data type carrying a value
0x00	Largest sub-index supported	U8	ro		M	-	
0x01	Data type name	Visible string 0-20 char.	ro	See variable data list	M	SDO	The name of the data type defined by this 0x3xxx index group.

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O	Default COB-ID/Com. obj	Note
Ox02	Number of instances of this data type	U8	ro	0x0F	M	Ex-SDO	The number of instances is typically 15 (0x0F) that is instance 1 to 15 of the same type of data. For example azimuth 1 to azimuth 15.
Ox03	Variable data type and format	U8	ro	0x00	M	Ex-SDO	The type of data stored in this data group: 0x00 Standard variable data actual and set point, format I16 with resolution identifier. 0x01 Standard variable data actual and set point, format U16 with resolution identifier. 0xF0 Dimmer data type 1 0xF1 Source identifier
-	Reserved						
0x3001	Instance 1 of this data type	REC			C		
0x00	Largest sub-index supported	U8	ro	0x2F	M	-	
0x01	Source name: {This is a menu, so the text in this field must be used as the menu text}	Visible string 0-20 char.	rw	Az/Rd1	O	SDO	Default name for this index for example “Rudder 1”. To be able to change this name is optional, but it is very useful to precisely identify the location of the device, for example “STBD Rudder 1”. The default name is located in the VI setup file.
0x02	Variable source data	I16 (U16)	rw	0x7FFF	C	XDi-net	The main data value of this data type is always located in sub-index 0x02, and it is used by an indicator as source data. Valid data range is indicated. For angle data it may be: Range: -1800 – 0 – 1800 or 0xF8F8 – 0 – 0x0708 Out of range is defined: 0x8000 = Out of range “–“ (or 0xF8F7 - 0x8000) 0x7FFE = Out of range “+” (or 0x0709 - 0x7FFE) Additional information may be added: Positive value is STBD and negative is PORT. Error: 0x7FFF = is set according to general rules.

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O	Default COB-ID/Com. obj	Note
0x03	Data resolution (angle)	I8	ro	0xFF	O	Ex-SDO	Indicates how data in sub-index is to be interpreted, A x 10^r where [r] is the resolution parameter in this index Important: this is a fixed parameter for each data type in the data directory version used. 0xFD equals 0.001 0xFE equals 0.01 0xFF equals 0.1 0x00 equals 1 0x01 equals 10 0x02 equals 100 1x03 equals 1000 (See CiA 303 for details) Example: if the value in sub-index 02 = 2000 and resolution = 0xFF (r = -1) then the data value is $2000x10^{-1}$ equal to 200.0 0x7E restricted 0x7F = data is full 16 bit range (I16) (not restricted).
0x04	Data unit (angle in degrees) Not supported - reserved	U8	ro	0x41	O	SDO	Data unit notation index, the standard codes for data units can be found in CiA 303. This is a fixed unit for the data directory and cannot be changed. In this case: 0x41 = Degree This is not used in the present XDi release.
0x05	Change sequence number SEQ#	U16	rw	0x0000	M	XDi-net Ex-SDO	Standard change identification is described elsewhere in this document.
0x06	Set point source name:	Visible string 0-20 char	rw	Az/Rd1 TBD	O	SDO	Default name for the set point for this data type, for example “Rudder 1 command”. See source name for more details.
0x07	SET POINT value	I16 (U16)	rw	0x7FFF	O	XDi-net	The set point value for the data type. (Data unit is the same as main data).
0x08	SET POINT Data resolution	I8	ro	0xFF	O	Ex-SDO	Same format as for actual data value 0x02. Typically it is the same resolution as the actual source value.
0x09	Actual data presentation flag	U8	rw	0x01		Ex-SDO	Flag that indicates the presentation status of the data type. 0x00 = Hide actual data of this type 0x01 = Present actual data of this type 0x02...0xFF reserved

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O	Default COB-ID/Com. obj	Note
0x0A	Set point data presentation flag	U8	rw	0x01	O	Ex-SDO	Flag that indicates the presentation status of the data type. 0x00 = Hide actual data of this type 0x01 = Present actual data of this type 0x02...0xFF reserved
.....	Reserved						
	Critical band 1						Used for sector marking on indicator
0x10	Critical band 1 High: {Pair1}	I16	rw	0x7FFF	O	Ex-SDO	Value referred to is sub-index 0x02 range 0x7FFF = Band is not used.
0x11	Critical band 1 Low: {Pair1}	I16	rw	0x7FFF	O	Ex-SDO	Value referred to is sub-index 0x02 range 0x7FFF = Band is not used.
0x12	Band 1 text:	Visible string 0-20 char.	rw	Band 1	O	SDO	
0x13	Band 1 text control flag	U8	rw	-	O	Ex-SDO	
0x14	Band 1 pointer colour select	U8	rw	-	O	Ex-SDO	Defines pointer colour, when within band. 0x00 = Normal 0x01 = Alert 0x02 = Warning
....	Reserved (band 1)						
	Critical band 2						Used for sector marking on indicator
0x18	Critical band 2 High: {Pair1}	I16	rw	0x7FFF	O	Ex-SDO	Value referred to is sub-index 0x02 range 0x7FFF = Band is not used.
0x19	Critical band 2 Low: {Pair1}	I16	rw	0x7FFF	O	Ex-SDO	Value referred to is sub-index 0x02 range 0x7FFF = Band is not used.
0x1A	Band 2 text:	Visible string 0-20 char.		Band 2	O	Ex-SDO	
0x1B	Band 2 text control flag	U8	rw		O	Ex-SDO	

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O	Default COB-ID/Com. obj	Note
0x1C	Band 2 pointer colour select	U8	rw	-	O	Ex-SDO	Defines pointer colour, when within band. 0x00 = Normal 0x01 = Alert 0x02 = Warning
....	Reserved (band 2)						
	Critical band 3						Used for sector marking on indicator
0x20	Critical band 3 High: {Pair3}	I16	rw	0x7FFF	O	Ex-SDO	Value referred to is sub-index 0x02 range 0x7FFF = Band is not used.
0x21	Critical band 3 Low: {Pair3}	I16	rw	0x7FFF	O	Ex-SDO	Value referred to is sub-index 0x02 range 0x7FFF = Band is not used.
0x22	Band 3 text:	Visible string 0-20 char.		Band 3	O	Ex-SDO	
0x23	Band 3 text control flag	U8	rw		O	Ex-SDO	
0x24	Band 3 pointer colour select	U8	rw	-	O	Ex-SDO	Defines pointer colour, when within band. 0x00 = Normal 0x01 = Alert 0x02 = Warning
....	Reserved (band 3)						
	Critical band 4						Used for sector marking on indicator
0x28	Critical band 4 High: {Pair3}	I16	rw	0x7FFF	O	Ex-SDO	Value referred to is sub-index 0x02 range 0x7FFF = Band is not used.
0x29	Critical band 4 Low: {Pair4}	I16	rw	0x7FFF	O	Ex-SDO	Value referred to is sub-index 0x02 range 0x7FFF = Band is not used.
0x2A	Band 4 text:	Visible string 0-20 char		Band 4	O	Ex-SDO	
0x2B	Band 4 text control flag	U8	rw		O	Ex-SDO	

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O	Default COB-ID/Com. obj	Note
0x2C	Band 4 pointer colour select	U8	rw	-	O	Ex-SDO	Defines pointer colour, when within band. 0x00 = Normal 0x01 = Alert 0x02 = Warning
....	Reserved (band 4)						
0x22	Reserved						
.....	Reserved						
	More instances of this data type						NOTE: the structure is the same for all instances of the data type.
0x3002	Instance 2 of this data type	REC					Same as 0x3001 default XDi-net
0x3003	Instance 3 of this data type	REC					Same as 0x3001 default XDi-net
.....							
0x300F	Instance 15 of this data type	REC					Same as 0x3001 default XDi-net

NOTE: Critical band is only working if the virtual indicator is designed with functions that utilise this function. For example, red sectors on an RPM indicator.

11.3.2 Object index structure for dimmer groups

Each dimmer group has a set of parameters. The most important for control via CAN is the actual dimmer level, sub-index 0x02 and the actual colour pallet 0x03 (if colour is not automatically controlled from the dimmer level).

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Com. obj.	Note
0x3500	Dimmer general definition						
							See index 0x3000 above for data type heading specification.
0x3501	Dimmer and colour pallet group 1	REC					System wide setup, all units using this dimmer group will store this setup and keep it updated if changes are made.
0x00	Largest sub-index supported	U8	ro		M	-	
0x01	Dimmer group name (short name)	Text string max. 20 char.	rw	DimGr.1	M	SDO	Max. 20 characters
0x02	Actual dimmer level	U8	rw	TBD	M	XDi-net (MPDO) (TPFO)	The dimmer level set for the group. Valid range 0-100 equal to 0 to 100 % backlight. For example controlled by the analogue input.
0x03	Actual colour pallet	U8	rw / ro	00	O	XDi-net Ex-SDO	Bit 0,1: 00 = Day 01 = Night 10 = Dusk 11 = Reserved (illegal value) Bits 2-7 are reserved (Don't care) Read only if auto pallet shift is active. If library only contains day/night pallet, then bit 1 must be ignored.
0x04	Change sequence number SEQ#	U32	rw	0x0000	M	XDi-net Ex-SDO	See detailed description of SEQ# and synch. process in this document.
0x05	Default dimmer start-up and menu level	U8	rw	50	O	XDi-net Ex-SDO	Default value at power-up (in %). Also used as minimum menu level. Local setting.
0x06	Dimmer colour pallet mode	U8	rw	0	O	XDi-net Ex-SDO	0x00 = Separate dim and colour 0x01 = Auto day/night 0x02 = Auto day/dusk/night >0x02 = Reserved

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Com. obj.	Note
0x07	Pallet shift level low Day or dusk to night	U8	rw	30	O	XDi-net Ex-SDO	Shift between: Mode 1: day and night (mode 1). Mode 2: dusk and night (mode 2). Shift to night at this input dimmer %. If shift is 0xFF function is inhibit.
0x08	Pallet shift level high Day to dusk	U8	rw	70	O	XDi-net Ex-SDO	Only mode 2. Shift between day and dusk. Shift from day to dusk at this input dimmer %. If shift is 0xFF function is inhibit.
0x09	Colour shift hysteresis %	U8	rw	0x01	O	XDi-net Ex-SDO	Hysteresis before dimmer makes a change, when going from a higher value to a lower value. 0 = No hysteresis, every step is used. 1 = 1 % change before shift. 2 = 2 % change before shift. 10 = 10 % change before shift.
0x0A	Day min. backlight level	U8	rw	0x00	O	XDi-net Ex-SDO	Sets the backlight level to a new min. level at the point where the colour pallet is just about to shift from day to dusk or night pallet. (Separate description is available).
0x0B	Dusk max. backlight level	U8	rw	0x00	O	XDi-net Ex-SDO	Raises the backlight level to a new max. level when the colour pallet has just shifted from day to dusk pallet. (Separate description is available).
0x0C	Dusk min. backlight level	U8	rw	0x00	O	XDi-net Ex-SDO	Sets the backlight level to a new min. level at the point where the colour pallet has just shifted from night to dusk pallet.
0x0D	Night max. backlight level	U8	rw	0x00	O	XDi-net Ex-SDO	Raises the backlight level to a new max. level at the point where the colour pallet is about to shift from night to dusk or day pallet.
0x0E	Min. global backlight offset level	U8	rw	0x00	O	XDi-net Ex-SDO	Lowest backlight level that equals lowest allowed dimming level. Backlight level offset range 0-50. Global setting.
0x3502	Dimmer and colour pallet group 2	REC					System wide setup, all units using this dimmer group will store this setup.
0x3503	Dimmer and colour pallet group 3	REC					System wide setup, all units using this dimmer group will store this setup.
0x3504	Dimmer and colour pallet group 4	REC					System wide setup, all units using this dimmer group will store this setup.

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Com. obj.	Note
0x3505	Dimmer and colour pallet group 5	REC					System wide setup, all units using this dimmer group will store this setup.
0x3506	Dimmer and colour pallet group 6	REC					System wide setup, all units using this dimmer group will store this setup.
0x3507	Dimmer and colour pallet group 7	REC					System wide setup, all units using this dimmer group will store this setup.
0x3508	Dimmer and colour pallet group 8	REC					System wide setup, all units using this dimmer group will store this setup.
0x3509	Dimmer and colour pallet group 9	REC					System wide setup, all units using this dimmer group will store this setup.
0x350A	Dimmer and colour pallet group 0 (Local)	REC					System wide setup, all units using this dimmer group will store this setup.

12 Appendix 4 - index 0x4000-4FFF product parameters

Product setup and status data is stored in this sector of the manufacturer-specific index.

Data in this section is individually set for each XDi unit in a CAN system and is therefore not synchronised by broadcast throughout the network. RW parameters in this sector can be changed using SDO, but some parameters are VS specific. Contact DEIF if information about specific VI is needed.

XDi index	Max # objects Instance	Object types	Note
0x4000 - 0x48FF	2304	Product and product profile	Note
0x4000	1	Product ID and profile type	
0x4001	1	Installed XDi library and data directory	
0x4002	1	Virtual indicator and VI setup selection	
0x4003	1	Product profile parameters	
0x4004	1	Dimmer and colour pallet	
0x4005	1	HW options	
0x4006	1	SW options	
0x4007	1	Library setup select	
0x4008-4009		Reserved	
0x400A-401F	21	Product data	Product setup, for example warnings, sound, HW monitor data...
0x4020-40FF	225	Reserved	
0x4100-42FF	512	Virtual indicator setup	
0x4100	1	Reserved (headline header)	
0x4101-410F	15	Headline lists	Selectable headlines (menu or CAN)
0x4110	1	Reserved (label header)	
0x4111-412F	31	Label lists	Selectable headlines (menu or CAN)
0x4130	1	Reserved (units header)	
0x4131-414F	31	Unit lists	Selectable headlines (menu or CAN)
0x4150	1	Reserved (scale header)	
0x4151-416F	31	Scale values	Local CAN programmable values used locally in the selected VI indicator
....			
0x4200	1	Reserved (source header)	
0x4201-0x423F	63	Source list	Selectable indicator data source list
....		Reserved	

12.1 Object index list 0x4000-0x40FF

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x4000 to 0x401F	Product profile for this XDi Node						Virtual indicator setup and XDi product profile data
0x4000	Product prof., library and VI setup	REC					
0x00	Largest sub-index supported	U8	ro		M	Ex-SDO	
0x01	Product Node-ID no.	U8	ro	0x01	M	Ex-SDO	The Node-ID of the XDi units that contain this XDi object index.
0x02	Product profile type	U16	ro	0x0000	M	Ex-SDO	0x0000 = XDi standard profile. If this has another value, the product profile section 0x4001-0x4xxx does not follow the description below. There will be another unique description. Valid range: 0x0000-0xFFFE 0xFFFF = Reserved
0x03	Hardware configuration	U16	ro	0x0000	M	Ex-SDO	0x0000 = Basis configuration. 0x0001-0x0FFF reserved for DEIF HW config. 0x1000 to 0x1FFF = Customer HW configuration. 0x2000 and up is reserved.
0x04	Product ID	U16	ro	0	M	Ex-SDO	Used for product identification and reference for logged reliability data in the product. Valid range: 10.001-11.000 (0x2711-2AF8) 0 for undefined.
0x05	Product S/N	String	ro	-	M	SDO	Used for product identification.
...	Reserved						
0x11	Platform SW version	U32	ro	-	C	Ex-SDO	Software version X.YZ.V (for example 1.23.4) represented in decimal XYZV (for example 1234) represented as hex value in the U32 format (for example 0x0000 04D2).
0x21	QT application SW version	U32	ro	-	C	Ex-SDO	Same
0x31	Console application SW version	U32	ro	-	C	Ex-SDO	Same
0x4001	Installed XDi library	REC					
0x00	Largest sub-index supported	U8	ro		M	Ex-SDO	
0x01	Reserved						

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x02	LIB owner ID number	U32	ro	-	M	Ex-SDO	Range: 0-4294967294 0xFFFFFFFF = Reserved
0x03	LIB number	U32	ro	-	M	Ex-SDO	Lib. number is allocated to each LIB owner. Range: 1-4294967294 Value 0x0...00 indicates that no LIB is loaded.
0x04	LIB name (ASCII) (short name)	Visible string	ro	-	O	SDO	Max. 20 characters in the library name. 0xF...FFFFFFF = Reserved.
0x05	LIB version	U32	ro	-	M	Ex-SDO	Version number is a figure starting at 1. Every time the library is updated and released for production, this number is increased by 1.
0x06	LIB revision	U32	ro	-	M	Ex-SDO	Library revision reference. Only relevant for DRAFT libraries, in between releases (version shift).
0x07	LIB status	U8	ro	-	M	Ex-SDO	Library status. 0x00: DRAFT 0x01: approved by DEIF/customer
0x08	LIB performance class					Ex-SDO	Not used – reserved.
....	Reserved						
0x4002	Virtual indicator and VI setup selection	REC					
0x00	Largest sub-index supported	U8	ro		M	Ex-SDO	
0x01	Total number of virtual indicators in LIB	U16	ro	-	M	Ex-SDO	Normally up to 100 VIs in one LIB. Range: 1-65534 0 indicates that no VIs are available in LIB. 0xFFFF is reserved.
0x02	Active virtual indicator number	U16	ro	0x01	M	Ex-SDO	
0x03	Active virtual indicator name (short name)	Visible string	ro	-	O	SDO	Max. 20 char. For example, Az_Pi_RPM1
0x04	VI approvals	U32	ro	-	M	Ex-SDO	Virtual indicator approvals Bit mask 0x00: Non 0x01: MED 0x02: 0x04:
0x05	VI status	U8	ro	-	M	Ex-	Virtual indicator status

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
						SDO	0x00: DRAFT 0x01: approved by DEIF/customer
....	Reserved						
	Virtual indicator setup:						
0x10	Total number of VI setup files for the active VI	U16	ro	-	M	Ex-SDO	Normally max. 50 VI setups for one virtual indicator. Range: 1-65534 0 indicates that no VI setup is available in LIB (for example the unit is a UC20). 0xFFFF is reserved.
0x11	Active VI setup file number	U16	ro	0x0001	M	Ex-SDO	
0x12	Active VI setup name (short name)	Visible string	ro	-	O	SDO	Max. 20 char. For example RPM input 1
0x4003	Product profile:	REC					
0x00	Largest sub-index supported	U8	Ro		M	Ex-SDO	
0x01	Total number of product profiles (PP) in this LIB	U16	Ro	-	M	Ex-SDO	Normally max. 50 product profiles in one XDi lib. Range: 1-65534 0 indicates that no PP is available in LIB. 0xFFFF is reserved.
0x02	Active PP file number	U16	ro	0x0001	M	Ex-SDO	
0x03	Active product profile name (short name)	Visible string	ro	-	O	SDO	Max. 20 char. For example PP17_Dim1_AutoColor
0x4004	Dimmer and colour pallet	REC					
0x00	Largest sub-index supported	U8	ro		M	Ex-SDO	

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x01	Selected dimmer group for this unit (Node-ID)	U8	rw	0x01	M	Ex-SDO	The dimmer group that this unit is assigned to follow. (Dimmer group settings are in 0x3500) Dimmer group 0x00 is local – no dimming via network 0x01 Group 1 0x02 Group 2 .... 0x08 Group 8 0x09 Group 9 0x0A to 0xFE is reserved (set to 0) 0xFF = Reserved
0x02	Dimmer source for this unit (Node-ID)	U8	rw	0x02	M	Ex-SDO	The active dimmer source for this unit: 0x00 = Digital option module 0x01 = Analogue option module 0x02 = XDi-net 0x03 = DAMPDO (controlled by CAN master) 0x04 = PDO converter (RPDO/TPDO input) 0x05 = Front buttons 0x06 = Front buttons and digital option (both) 0x07...0xFF reserved
0x03	Colour select source for this unit (Node-ID)	U8	rw	0x02	M	Ex-SDO	The active colour select source for this unit: 0x00 = Non – fixed colour 0x01 = Digital option module 0x02 = XDi-net 0x03 = DAMPDO (controlled by CAN master) 0x04 = PDO converter (RPDO/TPDO input) 0x05 = Front buttons 0x06 = Front buttons and digital option (both) 0x07...0xFF reserved
0x04	Min. local backlight level	U8	rw	0	O	Ex-SDO	Lowest backlight level that equals 0 % dimming input. Backlight level offset range 0-100. Local setting for the unit.

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x05	Max. local backlight level. Dimmer 100 % calibration	U8	rw	250	O	Ex-SDO	Parameter to adjust backlight setting to be equal to other XDi units (for example new/ old), local setting for the actual unit – not shared on CAN bus. Backlight level (scaled) = 0 to 250 Valid range for this parameter is 50 to 250. 255 = Not available or valid.
0x4005	HW options						
0x00	Largest sub-index supported	U8	ro		M	Ex-SDO	
0x01	Option type slot 1	U32	ro	-	C	Ex-SDO	TYPE: Byte 0: 0x00 = No module 0x01 = DX1 (digital module) 0x02 = AX1 (analogue module) 0x03 = NX 1 (serial data module) 0x04 = NX 2 (serial data module) >0x04 = Reserved for new modules 0xFF = Slot is not available in product. Bytes 1-3 are reserved.
...	Reserved						
0x11	Option type slot 2	U32	ro	-	C	Ex-SDO	Same as above for slot 1.
....	Reserved						
0x4006	SW options						
0x00	Largest sub-index supported	U8	ro		M	Ex-SDO	
0x4007	OD status handling						
0x00	Largest sub-index supported	U8	ro		M	Ex-SDO	

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x01	Select indicator and setup	U32	wo	-	C	Ex-SDO	Setup PP (product profile), VI (virtual indicator) and VS (virtual indicator setup). Byte 0: VS 1-255 Bytes 1-2: VI 1-65535 Byte 3: PP 1-255 Value will be set to command status when the command has been executed (after less than 30 seconds). Command status: 0xFFFFFFFF: ERROR 0x00000000: idle (new setup has been executed). 0xXXYYYYZZ: setup not changed (XX = old VS, YYYY = old VI, ZZ = old PP. The XDi already has this setup).
0x4008	Reserved						
.....	Reserved						
0x400A	Product warning setup						
0x00	Largest sub-index supported	U8	ro		M	Ex-SDO	
0x01	CAN1 bus error warning ON/OFF	U8	rw	0x01	M	Ex-SDO	0x00 = OFF 0x01 = ON Rest is reserved.
0x02	CAN2 bus error warning ON/OFF	U8	rw	0x01	M	Ex-SDO	0x00 = OFF 0x01 = ON Rest is reserved.
0x03	Supply voltage 1 monitor ON/OFF	U8	rw	0x01	M	Ex-SDO	0x00 = OFF 0x01 = ON Rest is reserved.
0x04	Supply voltage 2 monitor ON/OFF	U8	rw	0x01	M	Ex-SDO	0x00 = OFF 0x01 = ON Rest is reserved.
0x05	Data lost warning pop-up ON/OFF	U8	rw	0x01	M	Ex-SDO	0x00 = OFF 0x01 = ON Rest is reserved.

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x06	Parameter error ON/OFF	U8	rw	0x01	M	Ex-SDO	0x00 = OFF 0x01 = ON Rest is reserved.
0x400B	Product sound and display setup						
0x00	Largest sub-index supported	U8	ro		M	Ex-SDO	
0x01	Beep on key press ON/OFF	U8	rw	0x01	M	Ex-SDO	0x00 = OFF 0x01 = ON Rest is reserved.
0x02	Acoustic warnings ON/OFF	U8	rw	0x01	M	Ex-SDO	0x00 = OFF 0x01 = ON Rest is reserved.
0x03	Acoustic alerts ON/OFF	U8	rw	0x01	M	Ex-SDO	0x00 = OFF 0x01 = ON Rest is reserved.
0x04	Display rotation Normal/upside down	U8	rw	0x00	M	Ex-SDO	0x00 = Normal 0x01 = Upside down (rotated 180 deg.) Rest is reserved.
....							
0x401F	SDO write protection						
0x00	Largest sub-index supported	U8	ro	0x02	M	Ex-SDO	
0x01	Lock/unlock of SDO write	U32	rw	0x800 00000	M	Ex-SDO	0x7FFFFFFF: normal unlocked SDO (write) operation. 0x80000000: all manufacturer-specific profile parameters (0x2000...0x5FFF) are blocked for SDO (write) operations (except the SDO protection object index itself).
0x02	SDO write protection timeout	U16	rw	5000	M	Ex-SDO	0: no timeout on SDO (write) operation. SDO (write) operation is only controlled from sub-index 0x01. >0: timeout in [ms]. When time, since last successful SDO (write), exceeds timeout, force sub-index 0x01 value to 0x80000000. Value between 1...999 is forced to 1000, to ensure that timeout is never lower than 1000 [ms].
.....	Reserved						
0x40FF	Reserved						

12.2 XDi directory 0x4100-0x42FF definitions (virtual indicator setup)

12.2.1 Definition of text lists for virtual indicators 0x4100 to 0x414F

This object index section is used to store “text lists” of the following types: headline, label and unit.

For each list, sub-index 0x01 to 0x10 contains parameters that describe the text list.

The number of fixed text lines is limited to max. 32 lines (sub-index 0x11 to 0x30), and the number of empty lines in which new text lines may be entered via menu or via CAN bus is also limited to 32 lines (0x31 to 0x50).

A text list is only active if it is designed into the selected virtual indicator and pre-defined in the relevant VI setup profile.

NOTE: Adding or changing this type of text lines either via menu or via CAN will only affect the selected indicator and will not be shared globally.

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x4100	Data type “Headline list” definition						
0x00	Largest sub-index supported	U8	ro	0x2F	M	-	
0x01	Text label type name	Visible string 0-20 char.	ro	Head-lines	M	SDO	The name of the data type defined by this 0x4xxx index group.
0x02	Number of instances of this data type	U8	ro	0x0F	M		The reserved number of instances of this type is default 15 (0x0F). NOTE: instance in 0x4000 is not the same as for variable data in the 0x3000 area.
0x03	Data type and format	U8	ro	0x90	M		The type of data stored in this object type. See 0x3000 0x90 text lines
-	Reserved						
0x4101	Headline list 1 for the selected indicator	REC					Is used to present a headline from a pre-defined list of headlines. List and content is defined in the VI setup
0x00	Largest sub-index supported	U8	ro	0xXX	M	-	
0x01	Selected text line sub- index (TXTL)	U8	rw	0x00	M	Ex-SDO	The text is located in sub-index no. = 0x11 – 0x50 => TXTL Valid range 0x11 to 0x50. The line number must be validated when selected via menu. External CAN controller must validate this, if this sub-index has an invalid value the text line must be empty. If TXTL value is 0x00, the headline must be presented as empty (invisible).
0x02	Max. number of characters allowed in the text line	U8	ro	32	M	Ex-SDO	The number of characters may be limited by the indicator design, in that case this value is less than 32 and indicates the max. number of characters.

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x03	Number of fixed text lines (FTL)	U8	ro	01	M	Ex-SDO	This number indicates the number of available pre-defined text lines (cannot be changed – read-only). Fixed lines always start from 0x11 and upwards, new lines entered via menu are located after the last fixed line.
0x04	Number of new text lines (NTL)	U8	rw	01	O	Ex-SDO	This number indicates how many text lines that have been added as “new or editable text”.
.....	Reserved						
0x11	Fixed text line 1	Visible string 0-32 char.	ro	-	C M	SDO	Contains the text to be used as the first text line in the menu list and, if selected, presented on the virtual indicator as the headline. May be read as one string using normal SDO transfer.
0x12	Fixed text line 2	Visible string 0-32 char.	ro	-	C M	SDO	Contains the text to be used as the 2nd text line in the menu list and, if selected, presented on the virtual indicator as the headline. May be read as one string using normal SDO transfer.
....							
0x30	Fixed text line 32						
0x31	New text line 1	Visible string 0-32 char.	rw	-	C M	SDO	Contains the text to be used as the text line in the menu list and, if selected, presented on the virtual indicator as the headline. May be transferred (read/write) as one string using normal SDO transfer. If the string is not yet used but is available for use, it may contain an empty text string, defined by “” (should not be presented then for menu selection). It is allowed to add or delete the content of this type of string, by menu or CAN.
.....							
0x50	New text line 32						Last text line defined.
0x4102	Headline list 2	REC					
....							
0x410F	Headline list 15	REC					
0x4110	Data type “Label list” definition						
0x00	Largest sub-index supported	U8	ro	0x03	M	-	

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/ Comm.	Note Read-only data is copied from the XDi library loaded into the XDi-net product
0x01	Text label type name	Visible string 0-20 char.	ro	Labels	M	SDO	The name of the data type defined by this 0x4xxx index group.
0x02	Number of instances of this data type	U8	ro	0x1F	M		The reserved number of instances of this type is default 31 (0x1F). NOTE: instance in 0x4000 is not the same as for variable data in the 0x3000 area.
0x03	Data type and format	U8	ro	0x90	M		The type of data stored in this object type. See 0x3000 0x90 text lines
0x4111	Label list 1 for the selected indicator	REC					Is used to present a headline from a pre-defined list of headlines. List and content is defined in the VI setup
0x00...	Same format as for 0x4101						Same definition as for 0x4101, but labels instead of headlines.
0x4112	Label list 2	REC					
....							
0x412F	Label list 31	REC					
0x4130	Data type “Unit list” definition						
0x00	Largest sub-index supported	U8	ro	0x03	M	-	
0x01	Text label type name	Visible string 0-20 char.	ro	Units	M	SDO	The name of the data type defined by this 0x4xxx index group.
0x02	Number of instances of this data type	U8	ro	0x1F	M		The reserved number of instances of this type is default 31 (0x1F). NOTE: instance in 0x4000 is not the same as for variable data in the 0x3000 area.
0x03	Data type and format	U8	ro	0x90	M		The type of data stored in this object type. See 0x3000 0x90 text lines
0x4131	Label 1 for the selected indicator	REC					Is used to present a headline from a pre-defined list of headlines. List and content is defined in the VI setup
0x00...	Same format as for 0x4101						Same definition as for 0x4101, but labels instead of headlines.
0x4132	Unit list 2	REC					
....							
0x414F	Unit list 31	REC					

13 Appendix 5 - XDi error and fault indication

13.1 XDi-CAN bus error detection in mode

Mode #	XDi CAN mode	CAN1	CAN2
1	XDi-net	Active	Off
2	XDi-net – dual	Active	Active
3	Redundant CAN	Primary active	Secondary active

13.2 Error messaging on CAN

See section: object 0x1001 error register (mandatory) in this document for details.

Error message is sent in the emergency object: EMCY (0x080+Node-ID) using error register 0x1001.

Error register is found in CiA 301 table 48 (page 88) and in this document.

Emergency error code is found in CiA 301 table 21 (page 62).

Byte	0	1	2	3	4	5	6	7
Content	Emergency Error Code (table 21 in the CANopen CiA 301 standard)		Error register (Object 1001H)	Manufacturer specific Error Field				

Emergency error code:

Bit	Supported	Content
0	Yes	generic error
1	No	current
2	No	voltage
3	No	temperature
4	No	communication error (overrun, error state)
5	No	device profile specific
6	No	Reserved (always 0)
7	Yes	manufacturer specific

13.3CAN failure cause and type

Product profile setup options:
CAN1 bus error warning: ON or OFF
CAN2 bus error warning: ON or OFF
Settings can also be changed via user menu, but it is recommended to keep the two CAN bus errors warnings ON at all times.
Manufacturer-specific warning and alert group: CAN bus faults, range 0x01-0x1F.

CAN status/ failure	CAN 1	CAN 2	Warning type	When	Display pop-up text	Duration	Error register Obj. in. 0x1001	Emer-gency error code	CAN manufacturer-specific error code in EMCY	
									Warning Byte3	Alert Byte 4
Error reset or no error							0x00	0x0000	0x00	0x00
Used data is lost *)	OK->DL	OFF*	Warning	After 3 sec.	Data lost!	Until solved	0x81	0x8100	0x06	0x00
	OFF*	OK->DL	Warning	After 3 sec.	Data lost!	Until solved	0x81	0x8100	0x06	0x00

*) Data lost, CAN data that is needed for presentation on the active virtual indicator, but is not available at the moment,
OK = The right data is available.
NOTE: It is not possible to decipher which type of data is lost from the CAN message,

13.4Supply voltage failures

Product profile setup options:
Supply voltage 1 warning: **ON or OFF**
Supply voltage 2 warning: **ON or OFF**
Parameter can also be changed via user menu.
Manufacturer-specific warning and alert group: aux. voltage, range 0x20-0x2F.

Supply voltage status/ failure	Aux. voltage 1	Aux. voltage 2	Warning type	When	Display pop-up text	Duration	Error register Obj. in. 0x1001	Emer-gency error code	CAN manufacturer-specific error code in EMCY	
									Warning Byte 3	Alert Byte 4
After running >30 sec	OK -> NA	OFF	Warning	After 3 sec.	Power low!	Until solved	0x81	0x3000	0x21	0x00
	OFF	OK -> NA	Warning	After 3 sec.	Power low!	Until solved	0x81	0x3000	0x22	0x00
	OK->NA	OK	Alert	After 3 sec.	Power 1 lost!	Periodic *	0x81	0x3000	0x00	0x20
	OK	OK->NA	Alert	After 3 sec.	Power 2 lost!	Periodic *	0x81	0x3000	0x00	0x21
	OK->NA	OK->NA	Warning	After 3 sec.	Power 1&2	Until solved	0x81	0x3000	0x23	0x00

*) Periodic: see user interface description for details of duration.

OK = Supply voltage above trigger level (>18.5 +/-1 V DC) detected.

NA = Not available, either the supply has dropped out or it is below the trigger level.

14 Appendix 6 - MPDO parameter settings

The following appendix describes the correct settings of the communication parameters for MPDOs.

14.1 General CANopen header parameter settings

Unsigned 32

MSB						LSB
Bits	31	30	29	28 11	10	0
11 bit ID	0/1	0/1	0	000000000000000000	11-bit identifier	
29 bit ID	0/1	0/1	1	29-bit identifier		

Bit number	Value	Description
31 (MSB)	0	PDO exists / is valid
	1	PDO does not exists / is not valid
30	0	RTR allowed on this PDO
	1	No RTR allowed on this PDO
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID (CAN 2.0B)
28-11	0	If bit 29=0
	X	If bit 29=1: bits 28-11 of 29-bit-COB-id
10-0 (LSB)	x	bits 10-0 COB-id

14.2 SAM-MPDO communication parameter settings (index 0x1400-0x1403)

Used for XDi-net broadcast communication.

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/Com. obj.	Note
0x1400	Receive PDO parameter (setup for XDi-net)	PDO comm. Par.			M		
0x00	Largest sub-index supp.	U8	ro	0x02	M	Ex-SDO	
0x01	COB-ID used by PDO	U32	ro	0x27F	M	Ex-SDO	(Fixed in XDi-net)
0x02	Transmission type	U8	ro	254	M	Ex-SDO	Manufacturer-specific part of dir.
0x03	Inhibit time	U16	rw	Not used	O	-	Not used by XDi-net
0x04	Compatibility entry	U8	rw	Not used	O		Not used by XDi-net
0x05	Event timer	U16	rw	0x0000 = Not used	O		Not used

14.3SAM-MPDO mapping parameter settings (index 0x1600-0x17FF)

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/Com. obj.	Note
0x1600	Receive PDO1 mapping (set up as MPDO)	Rec			M		
0x00	Number of mapped application objects in PDO	U8	ro	0xFE	M	Ex-SDO	0xFE indicates that it is an MPDO in SAM (source address mode)

14.3.1DAM-MPDO settings

When an XDi unit is set up to accept DAM-MPDO input communication to the XDi-net object index directly from a CAN master or controller, one of the four default RPDOs is used for this.

The following shows the setup of RPDO2 as DAM-MPDO for an XDi unit, followed by a table giving the overview of how to set up all XDi-related RPDOs as multiplexed PDOs.

RPDO1 settings for use as DAM-MPDO2 with access to the XDi object index area.

Bit 31: 0 = PDO exists

Bit 30: 1 = No RTR allowed on this PDO

Bit 29: 0 = 11-bit ID

14.3.2 DAM-MPDO communication parameter settings (index 0x1400-0x1403)

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/Com. obj.	Note
0x1401	Receive PDO1 parameter (set up as MPDO)	PDO Comm. Par.			M		
0x00	Largest sub-index supp.	U8	ro	0x02	M	Ex-SDO	
0x01	COB-ID used by PDO	U32	ro	0x200+Node-ID	M	Ex-SDO	
0x02	Transmission type	U8	ro	254	M	Ex-SDO	Manufacturer-specific part of dir.
0x03	Inhibit time	U16	rw	Not used	O	-	Not used by XDi-net.
0x04	Compatibility entry	U8	rw	Not used	O		Not used by XDi-net.
0x05	Event timer	U16	rw	0x0000 = Not used	O		Set to “Not used” in XDi-net. Data transmissions depend on data type, and parameter change is only sent when they are changed.

14.3.3 DAM-MPDO mapping parameter settings (index 0x1600-0x17FF)

Index Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-ID/Com. obj.	Note
0x1600 - 0x1603	Receive PDO1 mapping (set up as MPDO)	Rec			M		XDi-net for Node-ID = 0x01
0x00	Number of mapped application objects in PDO	U8	ro	0xFF	M	Ex-SDO	0xFF indicates that it is an MPDO in DAM (destination address mode).

RPDO1-4 set up as MPDO and XDi-net setup

PDO type	COB-ID	Com. parameter	Mapping parameter	Mapping param. in sub-index 0x00
RPDO1	**0x200+Node-ID*)**	**0x1400**	**0x1600**	**0xFF(255) DAM**
RPDO2	0x300+Node-ID	0x1401	0x1601	0xFF(255) DAM
RPDO3	0x400+Node-ID	0x1402	0x1602	0xFF(255) DAM
RPDO4	0x500+Node-ID	0x1403	0x1603	0xFF(255) DAM

***) IMPORTANT:** when XDi-net is active, RPDO1 is reserved for XDi-net.

15 Appendix 7 - explanation of the “Obj. index table” fields

The description of all the indexes in the object index is made in table form with the following headline:

Index/ Sub-index	Object description	Obj. code Data type	Acc.	Default value	Cat. M/O.	Default COB-	Note

15.1 Index/sub-index

This column shows the index and sub-index. The index has the format 0x1234 whereas a sub-index has the format 0x12.

15.2 Object description

Describes the type and function of the index or sub-index.

15.3 Obj. code – data type

Describes the format of the data in the field, it may be a number of different formats from a text string to signed or unsigned hexadecimal value.

15.4 Acc. (access)

Defines the type of access to the index, it may be ro = read-only or rw = read and write.

15.5 Default value

Is the value assigned to the index as a default start parameter. Even though it may be defined in the table, it may be set differently in the actual object index table located in an XDi library.

15.6 Cat. M/O - object category in XDi-net

M = Mandatory (if an index is used by the indicator, some sub-indexes may be mandatory).

O = Optional.

C = Conditional if the index is used (for example if the index is used by the indicator).

CM = Conditional mandatory (if the XDi uses the main index/sub-index of the type conditional (C) or optional (O), and this other sub-index is needed (mandatory) when the main index is used.

15.7 Default COB-ID/communication object

This indicates the typical source of data on XDi-net and/or the communication data object type that is supported.

- COB-ID = 0xXXX when the data is coming from a pre-defined TPDO and Node-ID.
- MPDO = Multiplexed PDO addressed to the destination index/sub-index (DAM).
- MPDO-bc = XDi-net broadcast MPDO (= SAM-MPDO COB-ID: 0x27F) addressed to all XDi indicators on the network. (Only units that use this object index need to read it).
- (MPDO) means that if data is not calculated by the unit itself (calc. inhibit), data can be received in an MPDO.
- SDO = Normal service data object transfer (upload or download).
- Ex-SDO = Expedited SDO (fast data transfer of up to 4 byte, upload or download).
- (TPDO) indicates that by using the PDO converter and router, it is possible to convert and route a TPDO to this index/sub-index.
- (-) indicates that data is generated or calculated internally by the XDi unit itself.

16 Appendix 8 - EDS file description

16.1 Introduction

CANopen is designed for a system controlled by a central master, to which data of all sensors is sent, and the master will then distribute the data to all consumers that need the data.

Most systems that use XDi are built without a master, and data is distributed directly from the sensor (or controller) to the data consumer (indicator). The EDS file structure is made for the master-based system, and therefore direct data routing without a master is not included in the EDS.

The available EDS file for XDi is a generic type, which can be used to read and write the general CANopen parameters as described in the following.

The XDi indicator libraries contains an number of product profiles and virtual indicators, each with a number of different VS profiles = indicator setup profiles (This is VS profiles for both analogue and CAN input and some combinations).

In addition, it is possible to change a number of CAN parameters via the XDi installation menu.

This makes XDi easy to use in very many situations, but it makes it quite impossible to make specific EDS files for every combination of settings you can make when you go through the setup wizard and makes adjustments via menu.

That is why we only have the generic EDS file that includes the standard parameters, depending on how you use the XDi on CAN and which product profile, virtual indicator and VS setup profile you want to use, the EDS can be updated with the relevant information, but in most cases the easiest is to make a manual setup of the transmitting CAN system so that it sends the data needed in one or more TPDO's or using MPDO's (for example XDi-net format).

The generic EDS can be downloaded from: http://www.deif.com/software/software-download or it can be sent by email on request.
The library-specific input parameters must be handled manually or in combination with the general XDi EDS file.
The definition of all library-specific CAN parameters, for example CAN input for virtual indicators, are all found in the specification document that is made for each DEIF standard or customised XDi library.

16.2 EDS file - object index content

CANopen defines the first part of the object index from 0x1000 to 0x1FFF. The second part from 0x2000 to 0x5FFF is the manufacturer-specific part of the CANopen object index table.

You can find the detailed description in the relevant sections of this document.

16.2.1 CANopen defined object indexes, 0x1000 group

0x1000 Device type

0x1001 Error register

0x1002 Manufacturer status register

0x1008 Manufacturer device name

0x100A Manufacturer software version

0x100C Guard time

0x100D Lifetime factor

0x1010 Store parameter field

0x1011 Restore default parameters

0x1014 COB-ID emergency object

0x1016 Heartbeat consumer entries

0x1017 Producer heartbeat time

0x1018 Identity object

See Appendix 1 for details.

PDO parameters

The following parameters define the PDOs that will be used by the XDi itself for receiving or transmitting data.

The default settings in the generic EDS may be different in a customised library, and they may also change dependent on active virtual indicator/VI setup. It may therefore be necessary to adjust the EDS manually to fit the actual indicator and system.

Receive PDOs

0x1400 Receive PDO communication parameter 1

0x1401 Receive PDO communication parameter 2

0x1402 Receive PDO communication parameter 3

0x1403 Receive PDO communication parameter 4

0x1600 Receive PDO mapping parameter 1

0x1601 Receive PDO mapping parameter 2

0x1602 Receive PDO mapping parameter 3

0x1603 Receive PDO mapping parameter 4

The generic EDS is set up to define RPDO1 for XDi-net communication using SAM-MPDO, and RPDO2-4 are defined as DAM-MPDOs.

XDi-net is using the CANopen source address mode - multiplexed PDO communication format – SAM MPDO to broadcast data using the manufacturer-specific object index directory.

Index 0x1400-02 is set up for transmission type 0xFE (asynchronous, manufacturer-specified object index), and 0x1600-00 is set up for 0xFE (254), that means SAM-MPDO operation.

From CiA 301:

11.4.2.1 PDO Mapping Record

The meaning of Sub-Index 0 (number of mapped objects is extended. The valid range for non-multiplexed PDOs is 0 to 64. A value of 255 indicates a DAM-MPDO, a value of 254 indicates an SAM-MPDO.

For SAM, the further entries in the MR are don't care.

For DAM the first object describes the local object (there can be mapped only one object into an MPDO).

There are additional values allowed for the objects 1600h – 17FFh and 1A00h – 1BFFh Sub-Index 0h:

0 .. 64: Valid range for number of mapped objects

254: formatted as SAM-MPDO

255: formatted as DAM-MPDO

RPDO 2 to 4 are pre-defined for DAM-MPDO, also using manufacturer-specific object index directory.

This function is default off, but it can be activated in a customised "product profile" (PP), or it can be activated manually on the XDi from the CAN setup menu.

XDi supports one RPDO in DAM-MPDO mode. If you want to use that, it must either be activated in the PP in your custom XDi indicator library, or you will have to activate it via menu. (Ask DEIF product management if you want to use RPDO1 for other applications than XDi-net).

Transmit PDOs

The XDi is by default not transmitting any TPDOs, it has to be defined in the VI setup for the active virtual indicator.

0x1800 Transmit PDO communication parameter 1

0x1801 Transmit PDO communication parameter 2

0x1802 Transmit PDO communication parameter 3

0x1803 Transmit PDO communication parameter 4

0x1A00 Transmit PDO mapping parameter 1

0x1A01 Transmit PDO mapping parameter 2

0x1A02 Transmit PDO mapping parameter 3

0x1A03 Transmit PDO mapping parameter 4

By default, 0x1800 to1803 are set up to transmission type 0xFE (asynchronous, manufacturer-specified object index) and 0x1A00 to 1A03 are set up as deactivated.

If the virtual indicator is set up to share data in a TPDO, the correct parameter settings should be manually added to the EDS file, if needed in the CAN tool used for setup.

16.3 Manufacturer-specific CAN indexes, 0x2000 to 0x5FFF

The manufacturer-specific index section from 0x2000 to 0x5FFF controls the function of the XDi and acts as input to the XDi indicators and dimmer function. It is important to have a good understanding of XDi-net and the pre-defined parameters described in this section, before you start to make any changes.

0x2000: self-starting device defines the period of time after which the device enters operating mode.

16.3.1 Variable input data, 0x3000 group

The index range from 0x3000 to 0x3FFF with sub-indexes defines input parameters and network controls of virtual indicator presentations. The total list of indexes and sub-indexes is very long, and only a very small part of it is actually relevant in a given library and for the selected virtual indicator. Therefore, the total list is not added in the EDS.

Based on the library specification documentation and the description in Appendix 3, you may add the necessary 0x3000 group indexes to the standard EDS to access them via a CANopen system setup tool.

NOTE: An additional EDS file with indexes for some of the most used data types may be made available later, this is mainly of interest for XDi-net or DAM-MPDO data transfer.

The following indexes are general for all libraries and define the setup parameters for the 10 dimmer groups:

0x3500 Dimmer group (overall description)

0x3501 Dimmer group 1

0x3502 Dimmer group 2

0x3503 Dimmer group 3

0x3504 Dimmer group 4

0x3505 Dimmer group 5

0x3506 Dimmer group 6

0x3507 Dimmer group 7

0x3508 Dimmer group 8

0x3509 Dimmer group 9

0x350A Dimmer group 0 (local)

See the main document and Appendix 3 for details.

16.3.2 Product setup data 0x4000 group

The 0x4000 to 0x4FFF group of parameters is product-specific parameters and only refers to the actual XDi identified by its Node-ID. All these parameters can be read using SDO communication, but it requires an unlock, make change and lock procedure. This is to protect data from being accidentally changed.

IMPORTANT: Incorrect change of settings may cause the XDi to malfunction, and it may even have a global impact on all XDi units in a network if change of settings is distributed as an XDi-net synch. broadcast.

0x4000 PP library setup

0x4002 VI and VS selection

0x4003 PP parameter

0x4004 PP dimmer and colour palette

0x4005 PP hardware options

0x4006 PP software options

0x4007 PP object dictionary status

0x400A PP alarm setup

0x400B PP sound and display setup

0x401F SDO write protection

Headline lists

The following indexes are only used, if one or more headlines are available in the selected virtual indicator:

Selectable headline lists, one list is used for each headline on a virtual indicator:

0x4100 VS headline list group (header for the group)

0x4101 VS headline list 1

0x4102 VS headline list 2

0x4103 VS headline list 3

0x4104 VS headline list 4

0x4105 VS headline list 5

One index list is used for each headline that is used in a virtual indicator design.

Labels and units use a similar format, but since it has not been used in any library yet, it is not included in the present generic EDS file. If you require an updated generic EDS, contact DEIF product management.

Redundancy configuration parameters

The two CAN ports on the XDi can be set up for redundant CAN operation. The below index is only relevant when this function is activated.

0x1F60 Redundancy configuration parameters

For more details use: “CiA 307 Technical Report Proposal - Framework for maritime electronics”, where redundant system for marine applications and related parameters are described.

16.4 Standard CAN TPDO parameter examples:

16.4.1 Rudder angle:

To write Rudder data to the standard library you shall send the TPDO1 for Node1 that is COBID 0x181, it is default setup to match our RTC CAN transmitter that is transmitting the angle as a relative 16 bit signed value and data is located in byte 0 and 1.

This means that to send +45.0 deg (starboard) you must send the value 8191 (0x1FFF) in byte 0 and 1 (16 bit) in TPDO 0x181 and XDi will then scale it to 45.0 deg. internally stored as 450.

It is possible to change the scaling from the XDi menu to use absolute angle instead so that you just send the angle as +/-1800 (+/-180.0deg), if you need that I can give you a description of how to set that up in the XDi menu.

16.4.2 Pitch %:

In the standard libraries Pitch% can be sent as an absolute parameter +/-1100 (16 bit signed in byte 0 & 1) in TPDO 0x182. It has with 0.1 resolution internally in XDi 1100 = 110.0%.

16.4.3 RPM and RPM%

RPM is sent as an absolute parameter max +/-3275.0 as a 16bit signed value (+/-32675 = internal resolution 0.1 RPM). RPM data is sent in TPDO 0x183 in byte 0 and 1.

If a RPM% scale is used in the virtual indicator the RPM% value will be calculated by XDi based on +/-100% RPM values specified in the VS setup profile, it is possible to adjust the scaling parameters via XDi installation, input adjust menu.

(In a customized indicator the RPM and RPM% value can be sent as separate parameters.

It is possible to change to use other TPDO's or map data into one TPDO. This is possible from the XDi installation menu adjust input, but it is also possible and easiest is to have a custom library made, where we set the default setup parameters as needed for your system.

16.5 XDi-net data (SAM-MPDO)

Another way of transmitting CAN to XDi is by using the XDi-net protocol, then the data is sent in byte 0 and 1 as absolute values to the index mentioned in the table below. XDi-net will use RPDO1 in SAM-MPDO mode (Source address mode Multiplexed PDO).
The 0x3xxx CANopen indexes is part of the manufacture specific CAN object index table and are defined as input parameters in the XDi-net concept.

CAN input data examples:

Data type	COBID (TPDO's)	Mapped into byte	Data type	Typical data values and resolution	XDi –net Obj. index-sub. index
Azimuth angle actual (relative)	0x181	0 1	I16	+/- 32 767 relative	0x3001-02
Pitch angle actual (absolute)	0x182	0 1	I16	+/- 1800 Res. 0.1deg	0x3021-02
Pitch % actual (Calculated)	0x182	0 1	I16	+/- 1100 Res. 0.1 %	0x3031-02
Prop. RPM actual	0x183	0 1	I16	+/- 32765 Res. 0.1 rpm	0x3081-02
Prop. RPM% actual (Calculated)	0x183	0 1	I16	+/- 1000 Res. 0.1 %	0x3091-02

Example:

To transmit the rudder angle +40.0 degrees (SB) (400 = 0x190) to a rudder indicator setup to use input data via XDi-net (CANopen).

The following MPDO is sent to index 0x3001 sub index 02:

COB-ID: 0x201 (RPDO1 address 01, normally reserved for CAN Node ID 1)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
TX address	Index		Sub-index	Data LSB	Data MSB	Don't care	Don't care
0x01	0x01	0x30	0x02	0x90	0x01	0x00	0x00

In XDi-net mode all RPDO1 can be used as long as the format above is used. It is important that the Transmitter address identification 0xXX in COBID = 0x200+0xXX is the same 0xXX set in byte 0 !

And the MPDO string must be a full 8 byte PDO.

The full list of TPDO's used in the DEIF standard libraries can be downloaded from the DEIF FTP server. Please find the latest information about the standard libraries and relevant link to the FTP in the

"XDi standard virtual indicator library" document, located here: https://www.deif.com/documentation/xdi/